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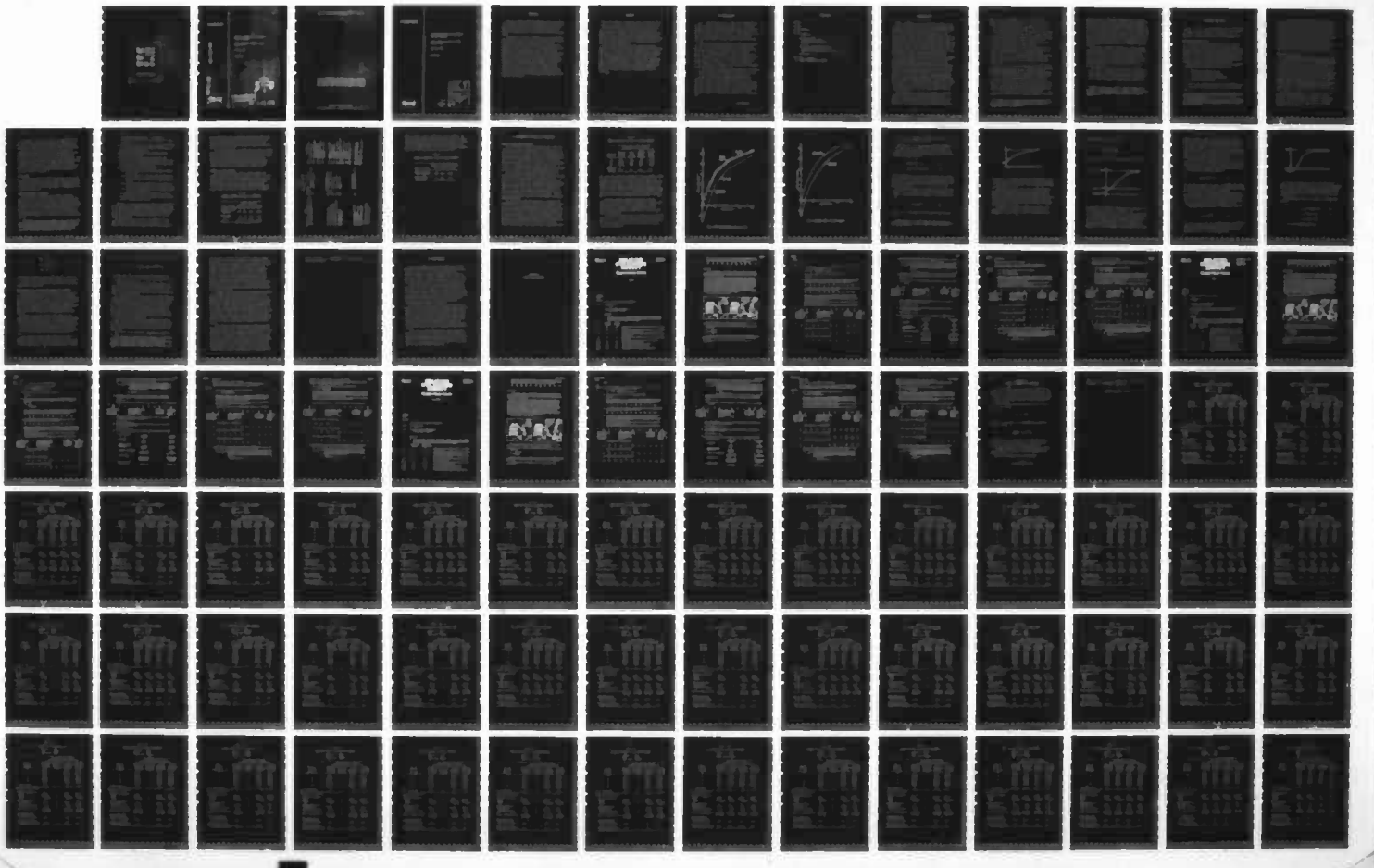

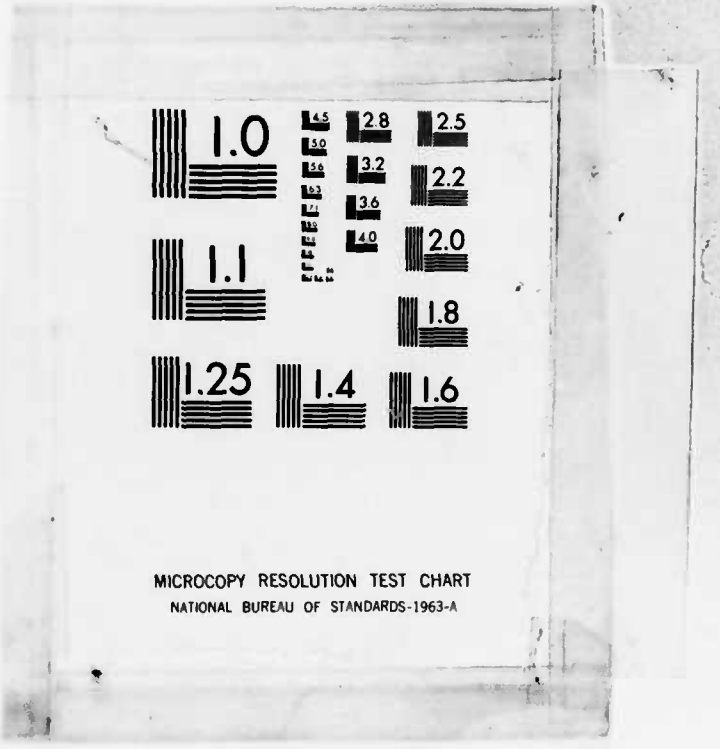
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A RAND NOTE

PRODUCTIVITY PROFILES OF FIRST-TERM ENLISTED PERSONNEL

Gus W. Haggstrom, Winston K. Chow, Robert M. Gay

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Rand
SANTA MONICA, CA. 90406

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PREFACE

This Note, sponsored by The Rand Corporation, was prepared as part of Rand's Manpower, Mobilization, and Readiness Program (now called the Defense Manpower Research Center). The research uses data from the Enlisted Utilization Survey, which was undertaken by Rand for the Cybernetics Technology Office of the Defense Advanced Research Projects Agency.

The purpose of the study is to quantify the role that on-the-job experience plays in the job performance of enlisted military personnel. The overall effectiveness of the armed forces depends on the contributions of individuals with varying levels of experience in a multitude of occupational specialties. The differing productivities of individuals at various points in their military careers are key considerations in assessing the advisability of personnel policies that affect overall experience levels in the armed forces. Historically, however, there has been little empirical evidence for evaluating the performance of enlisted personnel. The Enlisted Utilization Survey, a large-scale survey of trainee supervisors conducted in 1975, was especially designed to provide a data base for examining the job performance of trainees in a broad spectrum of military occupations. This Note uses those data to analyze the relationship between on-the-job experience and productivity ratings among enlisted personnel in the Army, Navy, and Air Force.

SUMMARY

This Note examines the relationship between on-the-job experience and productivity ratings of enlisted personnel in the Army, Navy, and Air Force. Using data from the Enlisted Utilization Survey, productivity profiles are constructed for 48 occupational specialties by pooling supervisors' estimates of trainees' net productivity at several points in their careers. These profiles show how trainees progress on average from their first month on the job through their first four years of service, thereby providing a means for assessing the importance of experience in military occupations.

In many of the occupational specialties covered by the study, ratings were obtained for both direct duty trainees and technical school graduates. Also, in addition to rating trainees under their direction, supervisors were asked to rate "typical" trainees in the same specialty (both technical school graduates and direct duty trainees) at four points in time beginning with the first month on the job. Productivity profiles constructed from the four sets of ratings provide comparisons between the actual job performances of technical school graduates and direct duty trainees as well as information about the supervisors' assessment of the value of military training programs for typical trainees.

ACKNOWLEDGMENTS

As the main author of this Note, I should like to acknowledge the help of many people. Heading the list is Robert Gay, the principal architect of Rand's Enlisted Utilization Survey (EUS). Bob provided the leadership, intellect, perseverance, and good humor needed to direct an innovative research effort of this magnitude. Bob enlisted Winston Chow and me to help analyze the EUS in 1977. Winston and I were ably assisted by Mark Albrecht, Pat Gowen, Dolph Hatch, Roberta Smith, and Elo Kabe.

Another important contributor to our work was Rick Cooper, who was the Director of Rand's Manpower, Mobilization, and Readiness (MMR) Program at that time. Rick incorporated some of our findings into his book, *Military Manpower and the All-Volunteer Force*, The Rand Corporation, R-1450-ARPA, September 1977. Robert Roll, who succeeded Rick as Program Director in 1979, also recognized the importance of this area of research and encouraged us to write a report summarizing our work on productivity profiles. The first draft of the report was completed in May 1980. I am grateful to Glenn Gotz and Rafe Stolzenberg for their thoughtful reviews of that draft.

I should also like to thank Glenn and James Hosek, current Director of the Manpower Program, for encouraging me to complete the study and for securing corporate funding to publish the finished product.

Finally, I should like to acknowledge my indebtedness to my esteemed colleague and friend, Winston Chow, who was killed in an automobile accident on November 22, 1980. Most of the statistical work reported in this Note was done by Winston in his inimitable painstaking, professional, elegant, and joyful manner. I feel fortunate to have had the pleasure of collaborating with such a talented scholar, whose delightful personality and demeanor brightened the lives of all who knew him.

Gus Haggstrom

CONTENTS

I. INTRODUCTION

On-the-job experience is valued in the military services, just as it is in the civilian sector, and there is an increasing awareness that shifting to a force with a higher proportion of senior personnel could enhance defense capability and reduce personnel costs. It is well recognized that, on average, career enlisted personnel are more productive than first-term personnel in the same occupational specialty. Also, a more senior force would mean less personnel turnover; fewer trainees would be required to fill vacancies in the ranks over time, and instructional time devoted to trainee indoctrination could be shifted to more productive tasks. On the other hand, personnel costs for senior personnel are higher than for first-term enlistees, and the crux of the issue is whether the productivity gains associated with higher experience levels are sufficient to offset the increased costs.

Time spent in training and in trainee supervision is a key element in weighing the advantages of a more senior force. Most military recruits undergo enlistment processing, basic training, and then specialized skill training before they reach their first duty stations, a process that typically takes four to eight months but can take more than a year in some occupational specialties. Moreover, the training process does not end when the individual arrives at his first duty station. No matter how good the military's formal training programs might be, most enlistees require additional on-the-job training before they can "pull their own weight" in their units. Indeed, some trainees' net contributions to unit productivity may be negative at first, because their contributions are more than offset by the forgone products of their supervisors, who must devote part of their productive time to trainee indoctrination.

As a trainee gains experience, his (net) productivity typically rises, not only because his own contributions increase with the acquisition of job-related skills, but also because he requires less supervision, enabling his supervisor(s) to contribute more to unit productivity. The time paths of the trainees' productivity measures,

which we call "productivity profiles," are of special interest to manpower researchers, because they reflect the enlistee's overall utility (or value) to the service.

Of course, it may be difficult, if not impossible, to estimate the individual productivities of members of the armed forces. But if estimates of these measures exist, comparisons of them across experience levels, defined either in terms of time in service or months on the job, provide essential ingredients for assessing the advisability of numerous personnel policies that affect experience levels (e.g., terms of enlistment contracts, reenlistment bonuses, promotion policies, and compensation differentials linked to years of service).

Until recently, little empirical evidence existed that could to be used to evaluate the productivities of enlistees at any point in time, let alone over the course of their military careers. Indeed, considering the difficulties associated with defining and measuring the product of, say, an armor crewman, a radio operator, or a military policeman, some would say that efforts to measure productivity are futile.

The Enlisted Utilization Survey (EUS) was a large-scale survey of trainee supervisors that attempted to fill this gap in manpower research and provide other information bearing on training costs and job performances of enlisted personnel.[1] The supervisors who participated in the survey were first apprised of the notion of net productivity. Then they were asked to evaluate the productivities (relative to specialists in the same occupational specialty with four years of service) for trainees under their immediate supervision as well as for "typical" technical school graduates and direct duty assignees in the same specialty. The survey instruments are reproduced in Appendix A.

The validity of the supervisors' ratings as measures of productivity and the availability of alternative measures are addressed

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[1]For a discussion of the rationale and multiple purposes of the EUS, see Robert M. Gay, *Estimating the Cost of On-the-Job Training in Military Occupations: A Methodology and Pilot Study*, The Rand Corporation, R-1351-ARPA, April 1974.

more fully elsewhere.[2] Since "true" measures of productivity do not exist in most (if not all) military occupations, absolute standards for assessing the validity of the supervisors' ratings are not available. Our view is that, whether the ratings are true measures of productivity or not, they are important measures of utility (or job performance) that merit study for the light that they can shed on the role that experience plays in a broad spectrum of military occupations. We leave it to the readers to adjudge the measurability of the productivity construct, the capacity of the supervisors to evaluate it, the appropriateness of the survey instruments, and the correctness of our treatment of the survey responses.

This study uses averages of the supervisors' ratings to estimate composite productivity profiles for first-term enlisted personnel in 48 occupational specialties in the Army, Navy, and Air Force. These profiles vary considerably across occupational specialties, but the shapes of the profiles are remarkably similar, and most are well fitted by simple "learning curves" having a negative exponential form. The productivity profiles and the learning curve characteristics are provided in Appendix B.

The remainder of this study is divided into three sections. Section II discusses the productivity measures used in this study and their limitations. Section III deals with the selection of functional forms of the learning curves and the calculation of the productivity profiles. Section IV contains conclusions based on this research.

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[2]Robert M. Gay and Mark J. Albrecht, "Measuring the On-the-Job Performance in Military Occupations," pp. 175-192, in Richard V. L. Cooper (ed.), *Defense Manpower Policy: Presentations from the 1976 Rand Conference on Defense Manpower*, The Rand Corporation, R-2396-ARPA, December 1978.

II. MEASURES AND DATA

This section describes the general characteristics of the measures of productivity and the data base used in this study. A more complete description of the characteristics of the data and of the data collection procedures will be provided in a forthcoming Rand report.[1]

MEASURES OF PRODUCTIVITY

The measures of on-the-job performance used in this study are derived from the Enlisted Utilization Study, a survey of trainee supervisors that was conducted in 1975. The survey questionnaires are reproduced in Appendix A. Almost 30,000 supervisors in the Army, Navy, and Air Force were surveyed. They were asked to provide two types of ratings: (i) ratings of the performance of specific trainees under their supervision, and (ii) ratings of "typical" new technical school graduates and direct duty trainees in the same specialty.

In evaluating specific trainees' net productivity, the supervisors were asked to provide ratings as of four points in time:

1. during the first month on the job,
2. at the time the rating was completed,
3. one year from the time of the rating, and
4. after four years of service.

For typical trainees, supervisors were asked to rate productivity during the first month on the job and after one, two, and four years on the job.[2]

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[1]Robert M. Gay and Mark J. Albrecht, *The 1975 Enlisted Utilization Study: Study Design and Data Collection Procedures*, The Rand Corporation, forthcoming.

[2]In cases where the estimate of the trainee's productivity was negative during the first month on the job, supervisors were also asked to estimate the number of months required for the trainee to achieve zero net productivity.

In the survey, supervisors were asked to rate net productivity relative to the typical individual with four years of experience in the same specialty. Using the typical specialist with four years of experience as the reference point made it possible to use the same instrument to obtain productivity estimates in a variety of specialties. The concept of net productivity was used because field work showed that a very important component of an individual's on-the-job training was the supervision he received from experienced personnel. This supervision entails an opportunity cost in the form of forgone productivity of supervisory personnel; consequently, an allowance must be made for the forgone productivity of supervisory personnel in estimating the net productivity of persons being trained on the job.

LIMITATIONS OF THE MEASURES

Useful measures of productivity are difficult to develop, and the subjective measures used here have several limitations. The largest potential source of difficulty was that supervisors might misconstrue the concept of net productivity. It was undoubtedly an unfamiliar concept for most supervisors, and it is reasonable to expect that the reliability and validity of the estimates would be affected. The accuracy could be affected because the respondents failed to understand the concept and/or because they were unable to put it into operation appropriately. Since most specialties involve performing a variety of tasks, trainees may be good at some and not at others. In some specialties there is no tangible product; in others there are numerous products. As a result, adapting the concept of net productivity to military occupations and estimating an individual's productivity can be quite difficult.

Another limitation of the measures used here is that supervisors were required to estimate not only each individual's current productivity but also to estimate what it had been during his first month on the job and what it would be in the future. Presumably, estimates of past and future performance are less accurate than estimates of current productivity.

Finally, since the "typical" technical school graduate and direct duty assignment trainee are not defined, one source of variation in estimates of the productivity of typical trainees may be differences among supervisors with respect to what constitutes the typical trainee.

In spite of these limitations, however, we feel that these estimates of productivity are useful. The relevant question is not so much whether this method of estimating first-term productivity is unflawed as it is whether the estimates provide useful information. The conceptual and practical problems associated with measuring productivity are sufficiently difficult that it is unlikely that any method of estimation can be developed that is not undesirable in some respects.[3] Moreover, to some extent, data cleaning procedures can compensate for the major limitation cited above.

DATA BASE

The data base used here was based on the responses of over 17,000 supervisors who completed about 27,000 ratings of specific individuals.[4] Of course, not all of the responses were usable. The remainder of this section describes the criteria that were adopted in selecting cases for inclusion in the analysis.

Criteria for Ratings of Individuals

The objective of this analysis is to construct productivity profiles for first-term enlisted personnel. These profiles represent the net productivity of first-term personnel as a percentage of the net productivity of the typical person in the same specialty with four years of experience. The survey responses were carefully screened prior to analysis to exclude cases that appeared not to provide a reasonable basis for estimating such a profile. Supervisors' ratings of specific individuals were included in our analysis only if the following criteria were met:

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[3]For a discussion of alternative methods of measuring productivity and their comparative strengths and weaknesses, see Robert M. Gay and Mark J. Albrecht, *Specialty Training and the Performance of First-Term Enlisted Personnel*, The Rand Corporation, R-2191-ARPA, April 1979.

[4]Since about one half the trainees were rated by more than one supervisor, approximately 18,000 different trainees were rated.

1. The trainee was serving his first term of service.
2. The trainee was working at his first duty station at the time of the survey.
3. At the time of the rating the trainee was assigned to job tasks in the specialty for which he was trained. (This applies to technical school graduates only.)
4. The supervisor confirmed that he was familiar with the trainee's work performance.
5. The supervisor provided estimates of the trainee's net contribution to unit production during his first month on the job, at the time of the rating, one year from the time of the rating, and after four years of service.
6. For a direct duty trainee, the supervisor:
   (i) felt qualified to evaluate the performance of a direct duty trainee;
   (ii) provided ratings for a typical trainee during his first month on the job, and after one, two, and four years on the job;
   (iii) provided a rating not exceeding 100 for the typical direct duty trainee during his first month on the job;
   (iv) provided a rating exceeding zero for the typical trainee after four years of service.
7. For a technical school graduate, the supervisor's responses satisfied conditions (i)-(iv) listed above restated in terms of a typical technical school graduate.

Conditions 1, 2, and 4 were designed to ensure that the supervisor has a reasonable basis for providing estimates for the trainee's entire first term of service. Condition 3 was imposed to ensure that technical school graduates were being evaluated in the specialty for which they were trained. Condition 5 ensured that the necessary data for this analysis were available.

Conditions 6 and 7 were imposed as a test of the supervisor's comprehension of the concept of relative net productivity. In our opinion a supervisor who rates the *typical* trainee as either equal to a

specialist with four years of experience during his first month on the job or as having zero net productivity after four years of service probably does not understand the concept. While either of these conditions could hold for specific individuals, neither is likely to be true for the typical trainee.

Table 1 shows the number of individual records included in our data base with these seven criteria imposed. This data base includes 16 Army specialties, 10 Navy specialties, and 22 Air Force specialties. Seven high skill Army specialties and four high skill Navy specialties included in the original data base were excluded from our analysis because fewer than 10 records remained after imposing these seven criteria. The final set of 48 specialties is listed in Table 2.

Criteria for Typical Trainees

The screening criteria for ratings of typical trainees were substantially simpler than those for ratings of individuals. The only issues to resolve here were those of completeness of the ratings and comprehension of the concept. Accordingly, ratings of the typical direct duty trainee were included if they satisfied conditions 6(i)-6(iv) above, and those of the typical technical school graduate were included if they satisfied conditions 7(i)-7(iv). The number of

Table 1

NUMBER OF RECORDS IN ANALYSIS OF INDIVIDUALS

	Number of Records			
Type of Trainee	Army	Navy	Air Force	Total
Technical school graduates	1444	1743	5321	8508
Direct duty trainees	96	27	641	764
Total	1540	1770	5962	9272

Table 2

SET OF SPECIALTIES

Army MOS[a]	Army Job Title	Navy Rating/NEC[b]	Navy Job Title	Air Force AFSC[c]	Air Force Job Title
High Skill Specialties					
26L	Tactical Microwave Systems Repairman	AE 8327	Jet Aircraft Electrical Systems Repairman (A-7)	304X4	Ground Radio Repairman
31E	Field Radio Repairman	ET	Electronics Technician	306X0	Electronic Communications and Cryptographic Equipment Systems Repairman
				326X0	Avionic Aerospace Ground Equipment Specialist
				326X1	Integrated Avionic Component Specialist
				326X2	Integrated Avionic Systems Specialiat
Medium Skill Specialties					
63H	Automotive Repairman	ADJ 8323	Jet Engine Mechanic (F-4)	421X3	Aerospace Ground Equipment Repairman
67N	UH-1 Helicopter Repairman	ADJ 8327	Jet Engine Mechanic (A-7)	422X1	Aircraft Environmental Systems Repairman
67U	CH-47 Helicopter Repairman	DT	Dental Technician	422X2	Aircrew Egress Systems Repairman
67V	OH-6/OH-58 Helicopter Repairman	EM	Electrician's Mate	423X0	Aircraft Electrical Syatems Repairman
73C	Finance Specialist	HM	Hospital Corpsman	431X1	Aircraft Maintenance Specialist
91B	Medical Specialist	RM	Radioman	432X0	Jet Engine Mechanic
91E	Dental Specialist			542X0	Electrician
				543X0	Electrical Power Production Specialist
				671X3	Disbursement Accounting Specialist
				902X0	Medical Service Specialist
				981X0	Dental Specialist
Low Skill Specialties					
11B	Light Weapons Infantryman	CS	Commissaryman (Mess Mgmt. Spec.)	552X0	Carpentry Specialiat
11E	Armor Crewman	MM	Machinist's Mate	571X0	Fire Protection Specialiat
12B	Combat Engineer			603X0	Vehicle Operator/Dispatcher
13B	Field Artillery Crewman			622X0	Cook
51B	Carpenter			631X0	Fuel Specialiat
64C	Motor Transport Operator			647X0	Material Facilities Specialiat
94B	Food Service Specialist				

[a] Military Occupational Specialty

[b] Naval Enliated Classification

[c] Air Force Specialty Code

usable supervisors' ratings in each service is given in Table 3. It should be noted that many supervisors provided ratings both for typical technical school graduates and typical direct duty trainees. The number of different supervisors who provided ratings of either the typical direct duty assignment trainee or the typical technical school graduate or both was: Army--2784; Navy--3742; and Air Force--4877.

Table 3

NUMBER OF SUPERVISORS' RATINGS OF TYPICAL TRAINEES

	Number of Supervisors' Ratings		
Type of Trainee	Army	Navy	Air Force
Typical technical school graduate	2348	3475	4434
Typical direct duty trainee	2110	2821	2454

III. ESTIMATION OF PRODUCTIVITY PROFILES

LEARNING CURVE SPECIFICATION

Each supervisor in the survey was asked to evaluate a particular trainee's net productivity during the first month on the job and at three other times: (1) the time of the survey, (2) one year after the survey, and (3) after four years of service. On the same questionnaire, those supervisors were also asked to evaluate the net productivity of a typical technical school graduate and a typical direct duty trainee during their first month on the job, and after one, two, and four years on the job. Averaging estimates for typical trainees over all supervisors in the same occupational specialty provides pooled estimates of their net productivities at the corresponding four time points.

Because the middle two points for supervisors' ratings of individuals depend on the trainee's amount of experience at the time the questionnaire was completed, they vary from trainee to trainee. However, the "time on the job" (TOJ) tends to fall between 10 and 14 months in most of the specialties. Among values of TOJ outside of this range, there are more cases for which TOJ exceeds 14 months than for which it falls short of 10 months. For the sake of uniformity, we decided to interpolate these individual ratings linearly to arrive at the same four ordinates as the ratings of typical trainees. Table 4 gives the average values of these productivity estimates for Air Force corpsmen (AFSC 902X0).

This table reveals a general characteristic of the productivity profiles that holds true for most of the specialties--supervisors tend to rate their own trainees higher than they rate the typical trainee. Moreover, even though not shown explicitly, those supervisors who rate the typical trainees higher (or lower) than the overall average among the supervisors also tend to rate their own trainees higher (or lower) than average. This presents another limitation to these productivity measures in that one cannot readily examine the trainees' productivity ratings without first knowing how the supervisors rate a typical trainee. As noted before, these typical trainees' ratings should serve

Table 4

AVERAGE PRODUCTIVITY ESTIMATES OF AIR FORCE CORPSMEN

Months on the Job	Average Productivity Estimates			
	Technical School Graduate	Direct Duty Trainees	Typical Technical School Graduate	Typical Direct Duty Trainee
0	10.2	12.1	-1.7	-31.4
12	65.1	62.4	62.5	39.8
24	87.7	86.9	85.7	71.1
48	107.2	109.3	107.7	99.7
Number of ratings	229	193	264	275

as a control for possible supervisor biases if further analyses of these productivity ratings are to be carried out using these data. The average net productivity estimates shown in Table 4 are plotted against months on the job in Figure 1. The points have been connected by line segments to provide polygonal learning curves passing through each set of four time points. However, it seems reasonable to assume that smooth curves can be fitted to these points, which will provide more realistic productivity curves than the piecewise linear curves shown. See Figure 2.

An implicit assumption underlying our analysis of fitting productivity curves is that trainees' net productivity relative to that of the average specialist with four years' experience in the MOS increases over time according to a "learning curve" that can be estimated reliably from a cross-sectional analysis of the supervisors' ratings in the specialty.

In considering functional forms for the learning curve y(t) for the typical trainee in a particular occupational specialty, we were led by a desire to have a specification with only a few parameters that would fit the data well and would satisfy the following conditions for given values of the parameters:

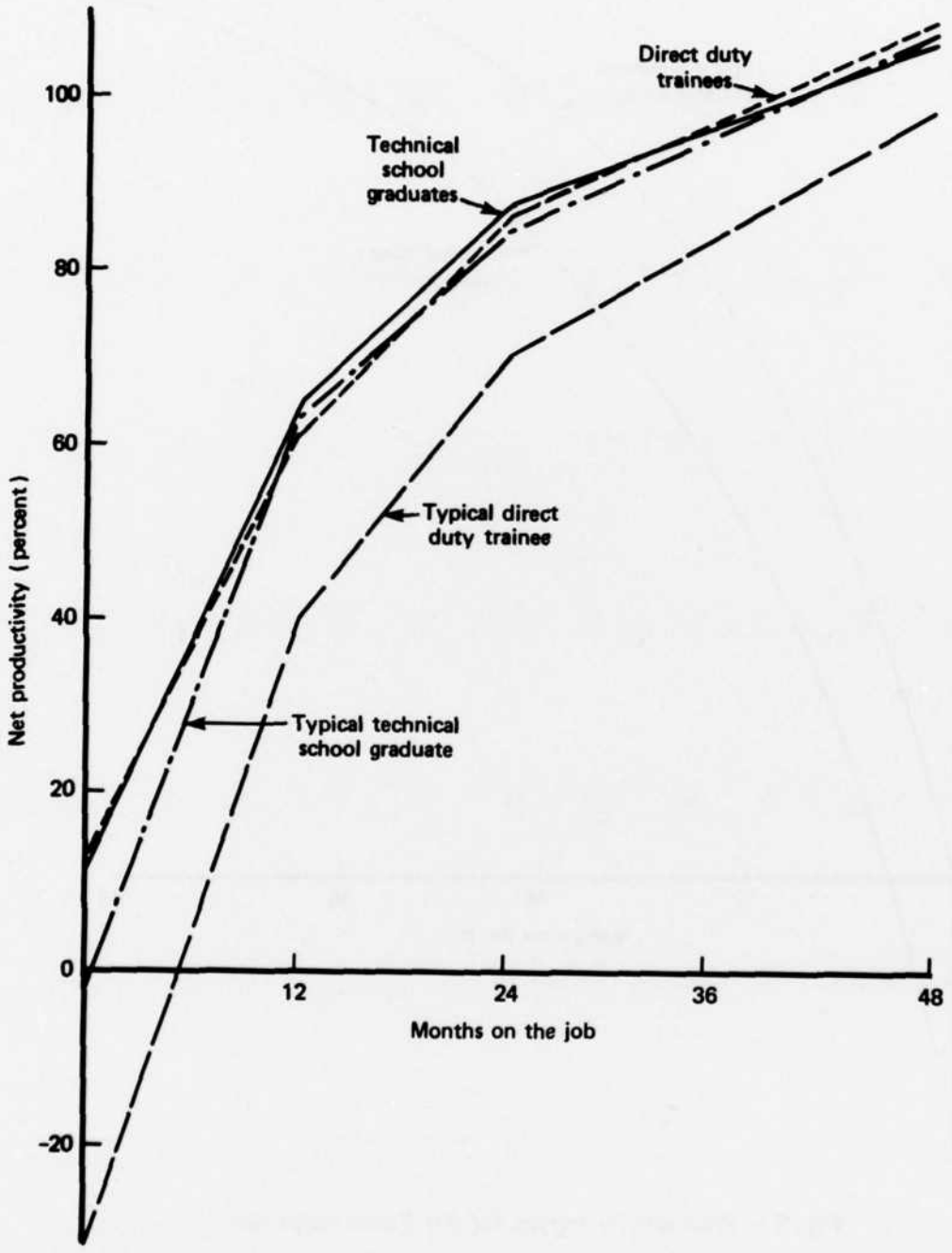

Fig. 1 – Productivity estimates for Air Force corpsmen

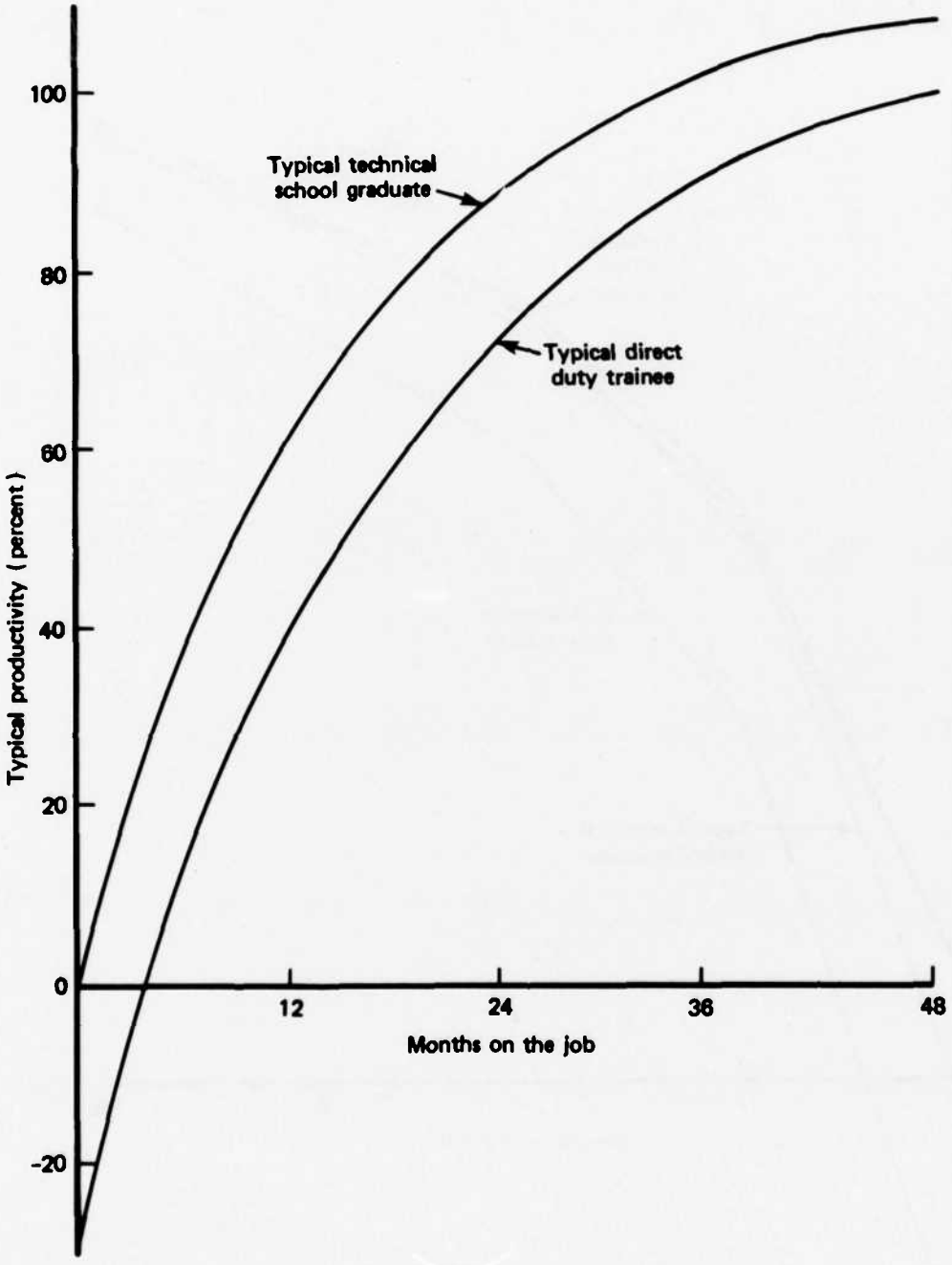

Fig. 2 — Productivity curves for Air Force corpsmen

i. $y(t)$ is an increasing, differentiable function of t for $t \geq 0$.

ii. $y(t)$ tends to a limit α as $t \to \infty$.

A common method of specifying parametric forms for learning curves is to prescribe that the "learning rate" dy/dt satisfy an equation involving some of the parameters that characterize the learning curve. For example, two common specifications of learning curves arise from the following differential equations:

$$dy/dt = \gamma(\alpha - y) \qquad (1)$$

$$dy/dt = \gamma(y - \delta)(\alpha - y). \qquad (2)$$

Following Gullicksen,[1] the solutions of these equations will be called Type A and Type B learning curves. Here and in the equations to follow, Greek letters specify the parameters of the growth curves, which can be estimated from observations over time on individuals that exhibit similar learning patterns.

As Equation (1) indicates, Type A learning curves result from the assumption that the learning rate is proportional to the amount yet to be learned. The general solution of Equation (1) can be written in the form

$$y = \alpha - \beta e^{-\gamma t}. \qquad (3)$$

For $\gamma > 0$ and $\beta < \alpha$, the graph of this curve has the shape indicated below.

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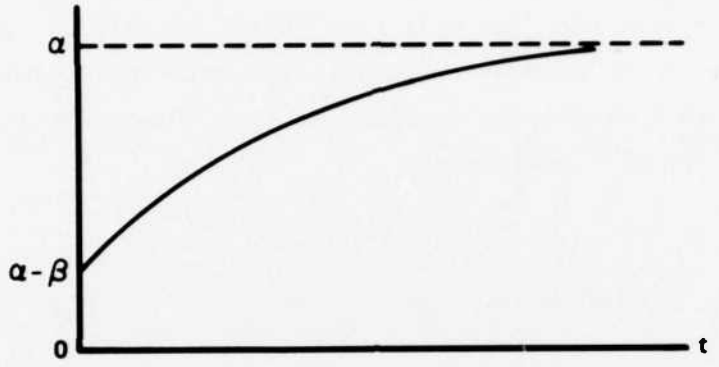
[1]Harold Gullicksen, "A rational equation of the learning curve based on Thorndike's law of effect," *Journal of General Psychology*, Vol. 11, 1934, pp. 395-434.



The parameters of this model are readily interpreted using Equation (1) and the fact that β is the difference between the limiting value α and the y-intercept of the learning curve. That is, β represents the amount yet to be learned at t = 0.

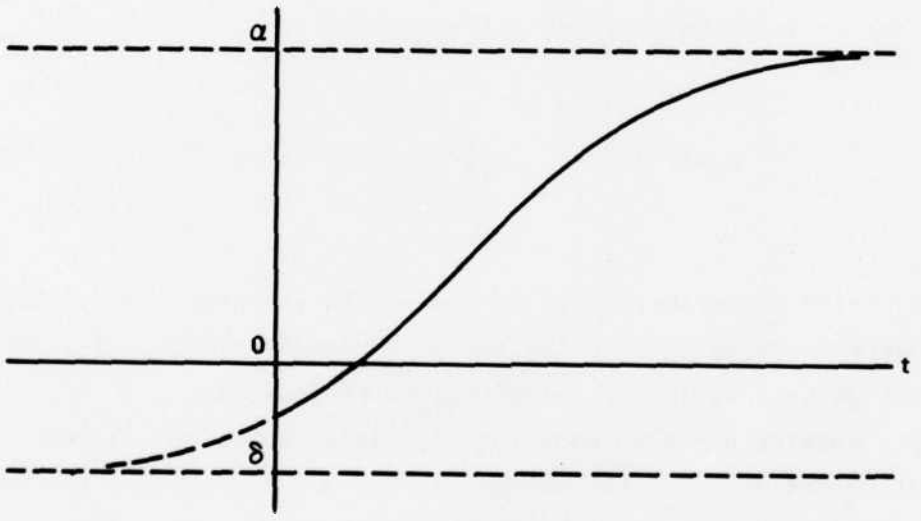
Although learning curves of Type A seem to fit the supervisors' estimates of the productivity curve quite well in many occupational specialties, this specification has certain shortcomings. For one thing, no specification of the parameters can yield an S-shaped curve in the event that the productivity curve for a particular specialty is relatively flat for small values of t and then increases more rapidly for larger values of t.

This objection is overcome by learning curves of Type B. The general solution to Equation (2) is a logistic growth curve with asymptotes $y = \alpha$ as $t \to \infty$ and $y = \delta$ as $t \to -\infty$. The equation of the

growth curve can be written in the form

$$y = \delta + \frac{\alpha - \delta}{1 + \beta e^{-\gamma(\alpha-\delta)t}} \qquad (4)$$

The graph of this curve for $\delta < 0 < \alpha$ and $\beta > 0$ looks like this:



The parameter β is related to the asymptotes and the y-intercept of the growth curve by the equation $\beta = [\alpha - y(0)]/[y(0) - \delta]$.

One shortcoming of curves of Type B is that there are two limiting values α and δ that must be specified *a priori* or estimated from the data. While an argument can be made for specifying α beforehand at, say, $\alpha = 100$ for the typical trainee, the other limiting value δ presents difficult estimation problems. The woeful experience of demographers in estimating asymptotes of logistic growth curves leads us

to shun this approach. Another shortcoming of these curves for our purposes is that, although the curves have four free parameters, no specification of the parameters may exist to provide logistic growth curves that pass through the four points derived from the supervisors' productivity estimates, such as those in Figure 2. One reason for the inability of Type B curves to mimic the actual learning curves is that logistic curves are necessarily symmetric about some point, whereas the actual trainees' productivity curves may not be.

Motivated in part by the goodness-of-fit of the Type A curves and the desire to incorporate a fourth parameter in the model to provide interpolation curves that pass through the supervisors' pooled estimates at four time points (as in Figure 2), we also considered the family of curves that satisfy the differential equation

$$dy/dt = \lambda t^{\mu}(\alpha - y) \qquad (5)$$

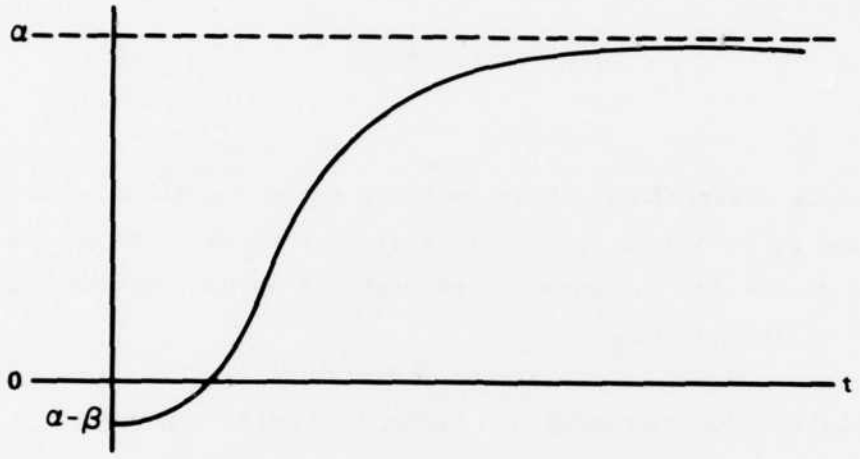
for some choice of parameters α, γ, and μ. In learning-theory jargon, this amounts to assuming that the learning rate is proportional to some power of t as well as to the amount yet to be learned.

Since setting $\mu = 0$ in Equation (5) yields Equation (1), this family of curves includes the curves of Type A. But, unlike the Type A curves, these curves can also be S-shaped. From Equation (3) we see that, if $\mu > 0$, then $y'(0) = 0$, which corresponds to the notion that the learning curve is relatively flat in a neighborhood of $t = 0$.

The general solution of Equation (5) can be written in the form

$$y = \alpha - \beta e^{-\gamma t^{\delta}} \qquad (6)$$

where $\delta = \mu + 1$ and $\gamma = \lambda/\delta$. As in the Type A curves, the parameter β in this model represents the amount yet to be learned at $t = 0$. In particular, if $\delta = 2$, the curve will look like an inverted normal density function for $t > 0$, as in the figure below.



In fitting curves of the form (6) to our data, we obtained estimates of δ that ranged from about 0.6 to 1.1. Values of δ less than 1.0 are not appealing, because the corresponding learning rates become infinite as t tends to zero. This undesirable property of the fitted curves and the goodness-of-fit of the curves of Type A led us to rule out these curves.

Other three-parameter families of learning curves that have some appeal are:

$$y = \alpha + \beta \log(1 + \gamma t) \qquad (7)$$

$$y = \alpha - \beta/(t + \gamma) \qquad (8)$$

$$y = \alpha + \beta(t + 1)^{\gamma}. \qquad (9)$$

The learning rates for these functions are:

$$dy/dt = \beta\gamma/(1 + \gamma t) \qquad (10)$$

$$dy/dt = \beta/(t + \gamma)^2 \qquad (11)$$

$$dy/dt = \beta\gamma(t + 1)^{\gamma-1}. \qquad (12)$$

With appropriate assumptions, these learning rates are all positive for $t > 0$ and tend to zero as t becomes infinite. However, none of these fit the data points for the supervisors' ratings as well as the Type A learning curves in Equation (3).

MEAN PRODUCTIVITY RATINGS AND PRODUCTIVITY CURVES

The mean productivity ratings and learning curves for each of the 48 occupational specialties in this study are reported in Appendix B. In each case, the four points (t, y_t), $t = 0, 12, 24, 48$, were fitted by least squares to Type A curves specified in Equation (3). The estimated values of the parameters α, β, and γ are also given in Appendix B. Since the unit of measurement for t is months, the estimated average net productivity of trainees at, say, 18 months can be determined by evaluating $\alpha - \beta e^{-18\gamma}$ for the values of the parameters given in the tables.

Appendix B also reports the "median training time" T for the trainees in each occupational specialty. This training time was defined to be the total elapsed time between the service entrance date and the date of arrival at the first duty station. Thus, T includes time spent in basic recruiting training, travel time, processing time, and time spent on leave. For technical school graduates, it also includes time required for formal training and time spent waiting for courses to begin.

Several statistics related to these fitted curves are also tabulated in Appendix B. They are the y-intercept, the slope at $t = 0$, residual sum of squares, total first-term productivity (P), and average first-term productivity (A). Total first-term productivity is defined

as the area under the fitted curve y(t) from 0 to 48-T divided by 100:

$$100P = \int_0^{48-T} y(t)\,dt = \hat{\alpha}(48-T) + (\hat{\beta}/\hat{\gamma})\,[e^{-\hat{\gamma}(48-T)} - 1].$$

The tabled values of P can be interpreted as man-month equivalents. The "average value" of the fitted curve over the interval from 0 to 48-T is defined by A = 100P/(48-T).

Under the assumption that each first-term enlistee remains in the service for four years, the amount of time he or she spends in a unit is 48-T months. The total first-term productivity P is relevant, for example, in comparing benefits of additional technical training with the costs incurred in such training.[2]

The learning curves fitted to the supervisors' ratings provide some interesting comparisons. The total productivities of typical technical school graduates are higher than that of typical direct duty trainees for almost all Army and Navy specialties. The Air Force results are mixed. The typical technical school graduates are rated above the direct duty trainees in all specialties except 304X4, 306X0, 326X1, 421X3, 423X0, and 603X0. These ratings indicate that, on average, the supervisors concur that formal technical training has positive effects on the overall first-term productivities.

However, the story is reversed when one compares the ratings for the actual trainees in the survey. Total productivities are higher for the direct duty trainees in all specialties for which ratings on direct duty trainees are available except for the Army specialties 11E, 12B, 91E, and 94B.

These results are not inconsistent. Assignments of trainees to

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[2]For a discussion of issues involved in comparisons of formal and on-the-job training, see Robert M. Gay, *Estimating the Cost of On-the-Job Training in Military Occupations: A Methodology and Pilot Study*, The Rand Corporation, R-1351-ARPA, April 1974; and Robert M. Gay and Mark J. Albrecht, *Specialty Training and the Performance of First-Term Enlisted Personnel*, The Rand Corporation, R-2191-ARPA, April 1979.

technical school or to direct duty stations are not made at random. They are based in part on the assessments of the trainees by personnel specialists who take into account the civilian education and employment records of the trainees. Although our information derived from personnel records of the trainees is spotty, there is considerable evidence to indicate that many direct duty trainees had worked in civilian jobs related to their specialties before they entered the service. We conjecture that, with few exceptions, the direct duty trainees were permitted to skip technical school on the basis of information indicating that technical school training would constitute an inefficient use of the trainees' time. Because of the selection biases involved, the evidence from the survey can neither substantiate nor refute this conjecture.

In comparing the total productivities of technical school graduates and direct duty trainees, one must keep in mind the fact that the measures are based upon different amounts of time on the job. Since many individuals reenlist and serve two or more terms, restricting the measure of total productivity to the first term of service may distort the measure. Although a uniformly small increase in net productivity due to technical school attendance may not compensate for the loss of total productivity during the first term of service due to time spent in training, it may be made up later. It is interesting that, despite these differences, the supervisors' ratings of typical trainees in most specialties support the conclusion that technical school training does not result in a loss of total productivity during the first term of service.

In the absence of a clearly defined product in many occupational specialties, the supervisors' ratings probably reflect evaluations of other characteristics, such as competence, industriousness, versatility, adaptability, leadership, and contributions to unit readiness. If so, the fact that the supervisors rate typical technical school graduates over the direct duty trainees in most specialties may reflect important technical school gains in factors that enhance unit performance but cannot be measured in terms of day-to-day activities. Taking these considerations into account, we interpret the supervisors' favorable ratings of typical technical school graduates as an endorsement of the

military's technical training programs in most of the specialties covered in this study.

IV. CONCLUSIONS

This Note has examined the relationship between experience and productivity among enlisted personnel in 48 occupational specialties in the Army, Navy, and Air Force. For each of the specialties, productivity profiles are provided in Appendix B that are based on supervisors' estimates of trainees' net productivity at four points in the trainees' career: (1) during the first month on the job, (2) one year later, (3) two years later, and (4) after four years of service.

Almost without exception, the four points corresponding to the means of the supervisors' ratings are well fitted by simple negative exponential curves, but the parameters vary widely across specialties. Not surprisingly, trainees in high skill specialties tend to have lower net productivity on average during the first month on the job and their total productivities during the first term of service relative to careerists in the same specialty are somewhat lower than the corresponding measures for lower skill trainees.

A comparison of supervisors' ratings of typical technical school graduates with those of typical direct duty trainees indicates that the supervisors believe the technical school graduates are generally more productive than direct duty trainees during their first four years of service. Although raw comparisons of the supervisors' ratings of the actual trainees in the survey would suggest that direct duty trainees outperform the technical school graduates, there is considerable evidence that many of the direct duty trainees had substantial amounts of training and experience in their specialties before they entered the service.

Since there is no clearly defined product in many occupational specialties, the supervisors' ratings probably reflect assessments of personal attributes commonly associated with high productivity such as competence and industriousness. Whatever the ratings measure in these cases, there is remarkable consistency in the patterns of the ratings over time and across occupational specialties.

Appendix A
SURVEY INSTRUMENTS

Rand
SANTA MONICA, CA 90406

DOD REPORTS
CONTROL SYMBOL:
DDM (OT) 7462

ENLISTED UTILIZATION SURVEY

Supervisor Form

ARMY

For Data Processing Only

■ CARD 01

Please print your MOS and Social Security number below:

31-35 ⌊_____⌋
MOS

36-44 ⌊___⌋ ⌊__⌋ ⌊____⌋
SOCIAL SECURITY NUMBER

SECTION I

1. Which of the following statements apply to the way first-term enlisted personnel are normally trained and utilized in your shop or section? (FOR BOTH AIT SCHOOL GRADUATES AND FORMAL OJT TRAINEES, CHECK EACH STATEMENT THAT APPLIES)

	AIT School Graduates	Formal OJT Trainees	
46-47	1. [ ]	1. [ ]	A trainee performs only very simple tasks during his first few weeks in the shop or section.
48-49	2. [ ]	2. [ ]	A trainee performs both simple tasks and tasks requiring specialized skills during his first few weeks in the shop or section.
50-51	3. [ ]	3. [ ]	A trainee works very closely with another specialist during his first few months in the shop or section.
52-53	4. [ ]	4. [ ]	Trainees frequently work independently even during their first few weeks in the shop or section.
54-55	5. [ ]	5. [ ]	A trainee works with the same supervisors throughout his training.
56-57	6. [ ]	6. [ ]	A trainee's supervisors change frequently.
58-59	7. [ ]	7. [ ]	A supervisor generally works with a group of trainees.
60-61	8. [ ]	8. [ ]	A supervisor generally works with only one trainee.
62-63	9. [ ]	9. [ ]	Classroom type instruction is conducted in the shop or section.

2. Approximately what percentage of his time on duty does the average qualified specialist spend performing job tasks which require training or experience in your specialty (as opposed to other types of work such as cleaning the work area or keeping records)? (CIRCLE ONE)

64-66 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

SECTION II

The following questions apply to individuals whose on-the-job performance should be familiar to you. One of the things we would like you to do is to rate their net contribution to unit production. Because the idea of net contribution to unit production is complicated, we have found that an example helps people understand what we mean.

Suppose an experienced specialist, *working alone*, can complete 10 jobs a day. If a trainee is assigned to work with him, the trainee will contribute to unit production by completing some jobs—say, 2 jobs per day. However, because the specialist must spend time supervising and instructing the trainee, his own production will drop. For example, he might now be able to complete only 5 jobs a day. In this case, the trainee's *NET* contribution to unit production is *negative* because the two people together are now completing fewer jobs than the experienced specialist was able to complete before the trainee was assigned to him. However, as the trainee gets more experienced, the combined production of the two men will increase. When they are able to produce 10 jobs a day, working together, the trainee's *NET* contribution to unit production will be *zero*, because the two men working together will be completing what the experienced specialist was completing before, working alone. When the supervisor and the trainee working together can complete *more* than 10 jobs a day, the trainee's *NET* contribution to unit production will be *positive*.

The pictures below illustrate another example.

The experienced cook can bake 15 pies a day when he works alone. When a trainee is assigned to work with him, the cook bakes only 8 pies a day and the trainee bakes 3 pies a day.

1. Would you say that the trainee's *NET CONTRIBUTION TO UNIT PRODUCTION at this time* is: (CHECK ONE)

67
[ ] 1. NEGATIVE
[ ] 2. ZERO
[ ] 3. POSITIVE

In the following questions you will be asked to estimate individuals' *NET CONTRIBUTION TO UNIT PRODUCTION*. We ask that you assume each individual will serve at least 4 years and remain in thia shop or section.

We realize that in many cases it will be difficult to give precise answers, but give the best estimates you can.

ARMY

■CARD

NAME

25-30

---

1. Are you familiar with this individual's work performance?

31

[ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(SKIP TO NEXT INDIVIDUAL)

2. Approximately how many months has this individual been with your unit?

32-33 MONTHS: _____

3. During his FIRST MONTH with your unit, approximately what percentage of his time on duty did this individual spend performing job tasks requiring training or experience in his specialty (as opposed to other types of work such as cleaning the work area or keeping records)? (CIRCLE ONE)

35-37

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. At the PRESENT TIME, approximately what percentage of his time on duty is spent performing job tasks requiring training or experience in his specialty? (CIRCLE ONE)

38-40

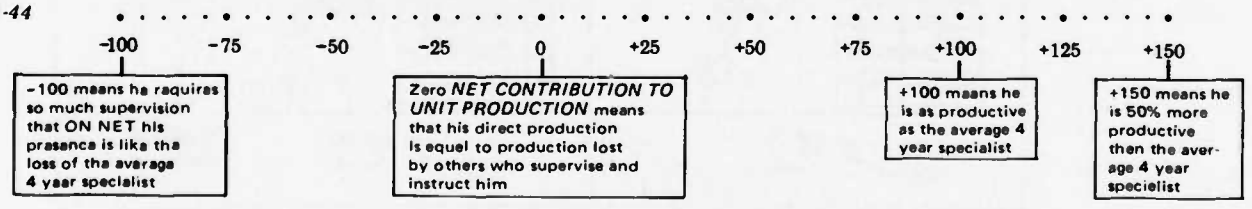
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. We would like you to estimate this individual's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with four years experience, how would you rate this individual's *NET CONTRIBUTION TO UNIT PRODUCTION*:

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

41-44



B. At the PRESENT TIME? (CIRCLE ONE DOT)

45-48

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

C. ONE YEAR from now? (CIRCLE ONE DOT)

49-52

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

53-56

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

6. Was this individual's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his FIRST month with your unit? (That is, was your answer to question 5A between −100 and 0?)

57 [ ] 1. YES → Approximately how many months do you estimate it took (or will take) from the time this individual first joined your unit until his direct production was about equal to the production lost by others who were supervising and instructing him? That is, how long was it until his *NET CONTRIBUTION TO UNIT PRODUCTION* was zero?

[ ] 2. NO

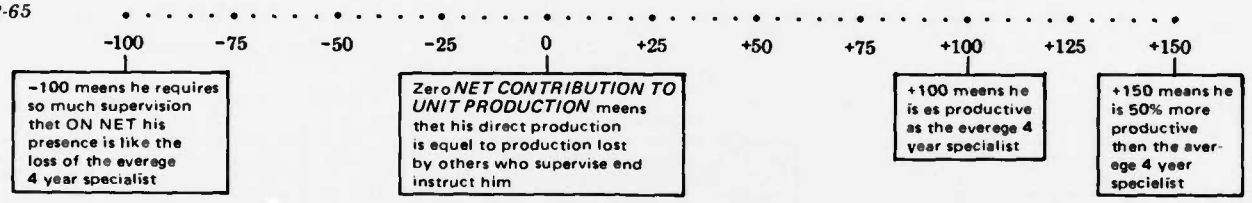
58-59 MONTHS: _____

7. Approximately how many months do you estimate it took (or will take) from the time this individual first joined your unit until he required about the same amount of supervision as a qualified specialist?

60-61 MONTHS: _____

7A. How would you rate his *NET CONTRIBUTION TO UNIT PRODUCTION* at that time? (CIRCLE ONE DOT)

62-65



8. During his FIRST MONTH with your unit, how many hours per week of direct personal supervision do you estimate this individual received from all supervisors?

66-67 HOURS PER WEEK: _____

9. At the PRESENT TIME, how many hours per week of direct personal supervision do you estimate this individual receives from all supervisors?

68-69 HOURS PER WEEK: _____

10. How would you rate this individual on each of the following? (CIRCLE ONE NUMBER IN EACH ROW)

70	A. WORK ATTITUDE	1 A very positive attitude	2	3	4	5	6	7 A very negative attitude
71	B. INITIATIVE	1 Great initiative	2	3	4	5	6	7 Very little initiative
72	C. COOPERATION WITH SUPERVISORS	1 Excellent cooperation	2	3	4	5	6	7 Very poor cooperation
73	D. AMOUNT OF SUPERVISION	1 Requires only nominal supervision	2	3	4	5	6	7 Requires constant supervision
74	E. LEVEL OF SKILL	1 Performs even the most complex tasks in the specialty	2	3	4	5	6	7 Performs only the simplest tasks in the specialty
75	F. SPEED OF WORK	1 Works very fast	2	3	4	5	6	7 Works very slowly

ARMY

SECTION III

PART A: TYPICAL NEW AIT SCHOOL GRADUATE

The following questions apply to the typical or average new AIT SCHOOL GRADUATE who joins your unit immediately after completing basic training and the AIT school course in your specialty.

*CARD 99

1. Do you feel qualified to evaluate the typical new AIT school graduate?

31

[ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(SKIP TO PART B)

2. We would like you to estimate the typical new AIT school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with 4 years experience, how would you rate the typical new AIT school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION:*

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

32-35

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

-100 means he requires so much supervision that ON NET his presence is like the loss of the average 4 year specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 year specialist

+150 means he is 50% more productive than the average 4 year specialist

B. AFTER 1 YEAR of service? (CIRCLE ONE DOT)

36-39

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

C. AFTER 2 YEARS of service? (CIRCLE ONE DOT)

40-43

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

44-47

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

3. Is the typical new AIT school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his first month? (That is, was your answer to question 2A between -100 and 0?)

48

[ ] 1. YES → Approximately how many months do you estimate it takes from the time the typical new AIT school graduate first joins your unit until his direct production is about equal to the production lost by others who supervise and instruct him? That is, how long is it until his *NET CONTRIBUTION TO UNIT PRODUCTION* is zero?

[ ] 2. NO

49-50

MONTHS: _____

ARMY

PART B: TYPICAL NEW FORMAL OJT TRAINEE

The following questions apply to the typical or average new FORMAL OJT TRAINEE who joins your unit immediately after completing basic training.

1. Do you feel qualified to evaluate the typical new formal OJT trainee?

51 [ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(STOP HERE)

2. We would like you to estimate the typical new formal OJT trainee's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with 4 years experience, how would you rate the typical new formal OJT trainee's *NET CONTRIBUTION TO UNIT PRODUCTION:*

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

52-55

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

-100 means he requires so much supervision that ON NET his presence is like the loss of the average 4 year specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 year specialist

+150 means he is 50% more productive than the average 4 year specialist

B. AFTER 1 YEAR of service? (CIRCLE ONE DOT)

56-59

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

C. AFTER 2 YEARS of service? (CIRCLE ONE DOT)

60-63

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

64-67

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

3. Is the typical new formal OJT trainee's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his first month? (That is, was your answer to question 2A between -100 and 0?)

68 [ ] 1. YES → Approximately how many months do you estimate it takes from the time the typical new formal OJT trainee first joins your unit until his direct production is about equal to the production lost by others who supervise and instruct him? That is, how long is it until his *NET CONTRIBUTION TO UNIT PRODUCTION* is zero?

[ ] 2. NO

69-70 MONTHS:_____

Rand
SANTA MONICA, CA 90406

ENLISTED UTILIZATION SURVEY

Supervisor Form

NAVY

BUPERS REPORTS SYMBOL
BUPERS 5314-17
DOD REPORTS
CONTROL SYMBOL:
DDM [OT] 7462

For Data Processing Only

■CARD 01

Please print your Rate and Social Security number below:

31-34 [ ][ ][ ][ ]
RATE

36-44 [ ][ ][ ] [ ][ ] [ ][ ][ ][ ]
SOCIAL SECURITY NUMBER

IF THIS DUTY STATION IS A SHIP, is the ship currently spending substantial amounts of time at sea? (IF THIS DUTY STATION IS NOT A SHIP, SKIP TO SECTION I, QUESTION 1)

45 [ ] 1. YES
[ ] 2. NO

SECTION I

1. Which of the following statements apply to the way first-term enlisted personnel are normally trained and utilized in your shop or section? (FOR BOTH "A" SCHOOL GRADUATES AND DIRECTED DUTY ASSIGNMENT TRAINEES, CHECK EACH STATEMENT THAT APPLIES)

	"A" School Graduates	Directed Duty Assignment Trainees	
46-47	1. [ ]	1. [ ]	A trainee performs only very simple tasks during his first few weeks in the shop or section.
48-49	2. [ ]	2. [ ]	A trainee performs both simple tasks and tasks requiring specialized skills during his first few weeks in the shop or section.
50-51	3. [ ]	3. [ ]	A trainee works very closely with another specialist during his first few months in the shop or section.
52-53	4. [ ]	4. [ ]	Trainees frequently work independently even during their first few weeks in the shop or section.
54-55	5. [ ]	5. [ ]	A trainee works with the same supervisors throughout his training.
56-57	6. [ ]	6. [ ]	A trainee's supervisors change frequently.
58-59	7. [ ]	7. [ ]	A supervisor generally works with a group of trainees.
60-61	8. [ ]	8. [ ]	A supervisor generally works with only one trainee.
62-63	9. [ ]	9. [ ]	Classroom type instruction is conducted in the shop or section.

2. Approximately what percentage of his time on duty does the average qualified specialist spend performing job tasks which require training or experience in your specialty (as opposed to other types of work such as cleaning the work area or keeping records)? (CIRCLE ONE)

64-66

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

SECTION II

The following questions apply to individuals whose on-the-job performance should be familiar to you. One of the things we would like you to do is to rate their net contribution to unit production. Because the idea of net contribution to unit production is complicated, we have found that an example helps people understand what we mean.

Suppose an experienced specialist, *working alone*, can complete 10 jobs a day. If a trainee is assigned to work with him, the trainee will contribute to unit production by completing some jobs—say, 2 jobs per day. However, because the specialist must spend time supervising and instructing the trainee, his own production will drop. For example, he might now be able to complete only 5 jobs a day. In this case, the trainee's *NET* contribution to unit production is *negative* because the two people together are now completing fewer jobs than the experienced specialist was able to complete before the trainee was assigned to him. However, as the trainee gets more experienced, the combined production of the two men will increase. When they are able to produce 10 jobs a day, working together, the trainee's *NET* contribution to unit production will be *zero*, because the two men working together will be completing what the experienced specialist was completing before, working alone. When the supervisor and the trainee working together can complete *more* than 10 jobs a day, the trainee's *NET* contribution to unit production will be *positive*.

The pictures below illustrate another example.

The experienced cook can bake 15 pies a day when he works alone. When a trainee is assigned to work with him, the cook bakes only 8 pies a day and the trainee bakes 3 pies a day.

1. Would you say that the trainee's *NET CONTRIBUTION TO UNIT PRODUCTION at this time* is: (CHECK ONE)

67

[ ] 1. NEGATIVE
[ ] 2. ZERO
[ ] 3. POSITIVE

In the following questions you will be asked to estimate individuals' *NET CONTRIBUTION TO UNIT PRODUCTION*. We ask that you assume each individual will serve at least 4 years and remain in this shop or section.

We realize that in many cases it will be difficult to give precise answers, but give the best estimates you can.

NAVY

■CARD

NAME

25-30

---

1. Are you familiar with this individual's work performance?

31 [ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(SKIP TO NEXT INDIVIDUAL)

2. Approximately how many months has this individual been with your unit?

32-33 MONTHS: _____

3. *IF THIS DUTY STATION IS A SHIP*, did the ship spend substantial amounts of time at sea during this individual's FIRST MONTH with your unit? (IF THIS DUTY STATION IS NOT A SHIP, SKIP TO QUESTION 4)

34 [ ] 1. YES
[ ] 2. NO
[ ] 3. UNCERTAIN

4. During his FIRST MONTH with your unit, approximately what percentage of his time on duty did this individual spend performing job tasks requiring training or experience in his specialty (as opposed to other types of work such as cleaning the work area or keeping records)? (CIRCLE ONE)

35-37 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. At the PRESENT TIME, approximately what percentage of his time on duty is spent performing job tasks requiring training or experience in his specialty? (CIRCLE ONE)

38-40 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

6. We would like you to estimate this individual's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with 4 years experience, how would you rate this individual's *NET CONTRIBUTION TO UNIT PRODUCTION:*

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

41-44

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

-100 means he requires so much supervision that ON NET his presence is like the loss of the average 4 year specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 year specialist

+150 means he is 50% more productive than the average 4 year specialist

B. At the PRESENT TIME? (CIRCLE ONE DOT)

45-48

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

C. ONE YEAR from now? (CIRCLE ONE DOT)

49-52

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

53-56

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

7. Was this individual's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his FIRST MONTH with your unit? (That is, was your answer to question 6A between -100 and 0?)

57 [ ] 1. YES → Approximately how many months do you estimate it took (or will take) from the time this individual first joined your unit until his direct production was about equal to the production lost by others who were supervising and instructing him? That is, how long was it until his *NET CONTRIBUTION TO UNIT PRODUCTION* was zero?

[ ] 2. NO

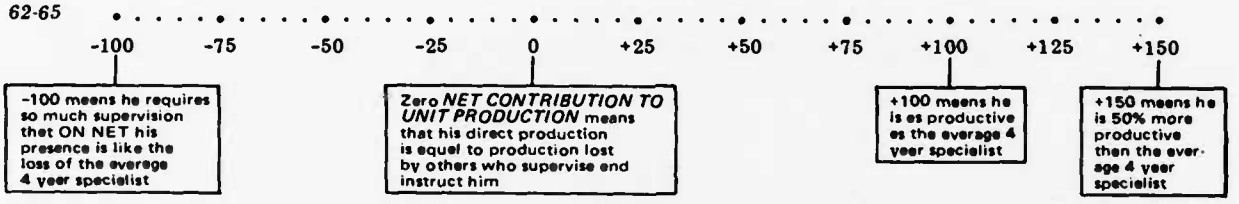
58-59 MONTHS: _____

8. Approximately how many months do you estimate it took (or will take) from the time this individual first joined your unit until he required about the same amount of supervision as a qualified specialist?

60-61 MONTHS: _____

8A. How would you rate his *NET CONTRIBUTION TO UNIT PRODUCTION* at that time? (CIRCLE ONE DOT)

62-65



9. During his FIRST MONTH with your unit, how many hours per week of direct personal supervision do you estimate this individual received from all supervisors?

66-67 HOURS PER WEEK: _____

10. At the PRESENT TIME, how many hours per week of direct personal supervision do you estimate this individual receives from all supervisors?

68-69 HOURS PER WEEK: _____

11. How would you rate this individual on each of the following? (CIRCLE ONE NUMBER IN EACH ROW)

		1	2	3	4	5	6	7
70	A. WORK ATTITUDE	A very positive attitude						A very negative attitude
71	B. INITIATIVE	Great initiative						Very little initiative
72	C. COOPERATION WITH SUPERVISORS	Excellent cooperation						Very poor cooperation
73	D. AMOUNT OF SUPERVISION	Requires only nominal supervision						Requires constant supervision
74	E. LEVEL OF SKILL	Performs even the most complex tasks in the specialty						Performs only the simplest tasks in the specialty
75	F. SPEED OF WORK	Works very fast						Works very slowly

NAVY

SECTION III

PART A: TYPICAL NEW "A" SCHOOL GRADUATE.

The following questions apply to the typical or average new "A" SCHOOL GRADUATE who joins your unit immediately after completing basic training and the "A" school course in your specialty.

■CARD 99

1. Do you feel qualified to evaluate the typical new "A" school graduate?

31

[ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(SKIP TO PART B)

2. We would like you to estimate the typical new "A" school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with four years experience, how would you rate the typical new "A" school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION:*

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

32-35

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

-100 means he requires so much supervision that ON NET his presence is like the loss of the everege 4 yeer specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 yaer specialist

+150 means he is 50% more productive than the average 4 yeer specialist

B. AFTER 1 YEAR of service? (CIRCLE ONE DOT)

36-39

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

C. AFTER 2 YEARS of service? (CIRCLE ONE DOT)

40-43

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

44-47

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

3. Is the typical new "A" school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his first month? (That is, was your answer to question 2A between -100 and 0?)

48

[ ] 1. YES → Approximately how many months do you estimate it takes from the time the typical new "A" school graduate first joins your unit until his direct production is about equal to the production lost by others who supervise and instruct him? That is, how long is it until his *NET CONTRIBUTION TO UNIT PRODUCTION* is zero?

49-50 MONTHS:_____

[ ] 2. NO

NAVY

PART B: TYPICAL NEW DIRECTED DUTY ASSIGNMENT TRAINEE.

The following questions apply to the typical or average new DIRECTED DUTY ASSIGNMENT TRAINEE who joins your unit immediately after completing basic training.

1. Do you feel qualified to evaluate the typical new directed duty assignment trainee?

51 [ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(STOP HERE)

2. We would like you to estimate the typical new directed duty assignment trainee's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section*. An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with four years experience, how would you rate the typical new directed duty assignment trainee's *NET CONTRIBUTION TO UNIT PRODUCTION:*

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

52-55

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

-100 means he requires so much supervision that ON NET his presence is like the loss of the average 4 year specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 year specialist

+150 means he is 50% more productive than the average 4 year specialist

B. AFTER 1 YEAR of service? (CIRCLE ONE DOT)

56-59

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +160

C. AFTER 2 YEARS of service? (CIRCLE ONE DOT)

60-63

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

64-67

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

3. Is the typical new directed duty assignment trainee's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his first month? (That is, was your answer to question 2A between -100 and 0?)

68 [ ] 1. YES → Approximately how many months do you estimate it takes from the time the typical new directed duty assignment trainee first joins your unit until his direct production is about equal to the production lost by others who supervise and instruct him? That is, how long is it until his *NET CONTRIBUTION TO UNIT PRODUCTION* is zero?

[ ] 2. NO

69-70 MONTHS:_____

Rand
SANTA MONICA, CA. 90406

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ENLISTED UTILIZATION SURVEY

Supervisor Form

AIR FORCE

For Data Processing Only

■CARD 01

Please print you AFSC and Social Security number below:

31-35 ⌊_____⌋ AFSC

36-44 ⌊___⌋⌊___⌋⌊____⌋ SOCIAL SECURITY NUMBER

SECTION I

1. Which of the following statements apply to the way first-term enlisted personnel are normally trained and utilized in your shop or section? (FOR BOTH TECHNICAL SCHOOL GRADUATES AND DIRECTED DUTY ASSIGNMENT TRAINEES, CHECK EACH STATEMENT THAT APPLIES)

	Technical School Graduates	Directed Duty Assignment Trainees	
46-47	1. [ ]	1. [ ]	A trainee performs only very simple tasks during his first few weeks in the shop or section.
48-49	2. [ ]	2. [ ]	A trainee performs both simple tasks and tasks requiring specialized skills during his first few weeks in the shop or section.
50-51	3. [ ]	3. [ ]	A trainee works very closely with another specialist during his first few months in the shop or section.
52-53	4. [ ]	4. [ ]	Trainees frequently work independently even during their first few weeks in the shop or section.
54-55	5. [ ]	5. [ ]	A trainee works with the same supervisors throughout his training.
56-57	6. [ ]	6. [ ]	A trainee's supervisors change frequently.
58-59	7. [ ]	7. [ ]	A supervisor generally works with a group of trainees.
60-61	8. [ ]	8. [ ]	A supervisor generally works with only one trainee.
62-63	9. [ ]	9. [ ]	Classroom type instruction is conducted in the shop or section.

2. Approximately what percentage of his time on duty does the average qualified specialist spend performing job tasks which require training or experience in your specialty (as opposed to other types of work such as cleaning the work area or keeping records)? (CIRCLE ONE)

64-66 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

SECTION II

The following questions apply to individuals whose on-the-job performance should be familiar to you. One of the things we would like you to do is to rate their net contribution to unit production. Because the idea of net contribution to unit production ia complicated, we have found that an example helps people understand what we mean.

Suppose an experienced specialist, *working alone*, can complete 10 jobs a day. If a trainee is assigned to work with him, the trainee will contribute to unit production by completing some jobs—say, 2 jobs per day. However, because the specialist must spend time supervising and instructing the trainee, his own production will drop. For example, he might now be able to complete only 5 jobs a day. In this case, the trainee's *NET* contribution to unit production is *negative* because the two people together are now completing fewer jobs than the experienced specialist was able to complete before the trainee was assigned to him. However, as the trainee gets more experienced, the combined production of the two men will increase. When they are sble to produce 10 jobs a day, working together, the trainee's *NET* contribution to unit production will be *zero*, because the two men working together will be completing what the experienced specialist was completing before, working alone. When the supervisor and the trainee working together can complete *more* than 10 jobs a day, the trainee's *NET* contribution to unit production will be *positive*.

The pictures below illustrate another example.

The experienced cook can bake 15 pies a day when he works alone. When a trainee is assigned to work with him, the cook bakes only 8 pies a day and the trainee bakes 3 pies a day.

1. Would you say that the trainee's *NET CONTRIBUTION TO UNIT PRODUCTION at this time* is: (CHECK ONE)

67 [ ] 1. NEGATIVE
[ ] 2. ZERO
[ ] 3. POSITIVE

In the following questions you will be asked to estimate individuals' *NET CONTRIBUTION TO UNIT PRODUCTION*. We ask that you assume each individual will serve at least 4 years and remain in thls shop or section.

We reslize that in many cases lt will be difficult to give precise answers, but give the best estimates you can.

AIR FORCE

■CARD

NAME

25-30

---

1. Are you familiar with this individual's work performance?

31

[ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(SKIP TO NEXT INDIVIDUAL)

2. Approximately how many months has this individual been with your unit?

32-33

MONTHS: _____

3. During his FIRST MONTH with your unit, approximately what percentage of his time on duty did this individual spend performing job tasks requiring training or experience in his specialty (as opposed to other types of work such as cleaning the work area or keeping records)? (CIRCLE ONE)

35-37

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. At the PRESENT TIME, approximately what percentage of his time on duty is spent performing job tasks requiring training or experience in his specialty? (CIRCLE ONE)

38-40

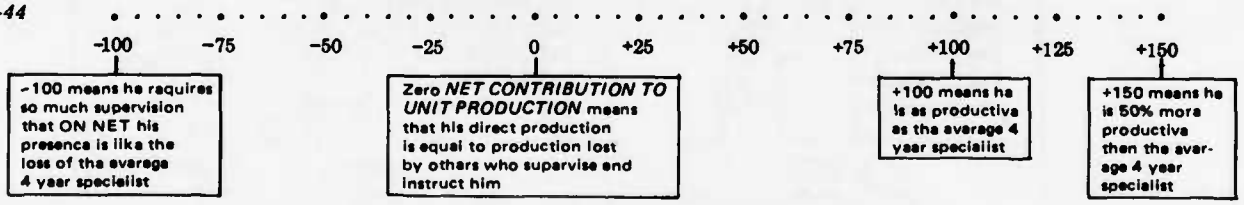
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. We would like you to estimate this individual's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with four years experience, how would you rate this individual's *NET CONTRIBUTION TO UNIT PRODUCTION:*

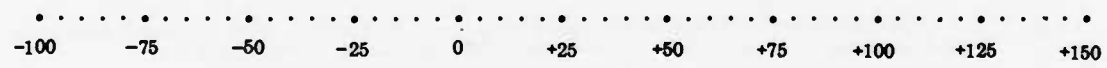
A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

41-44



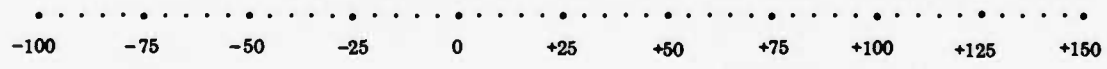
B. At the PRESENT TIME? (CIRCLE ONE DOT)

45-48



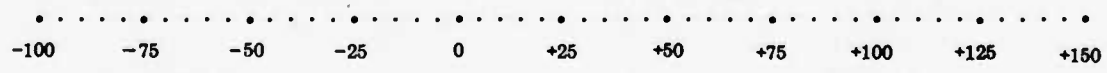
C. ONE YEAR from now? (CIRCLE ONE DOT)

49-52



D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

53-56



6. Was this individual's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his FIRST month with your unit? (That is, was your answer to question 5A between −100 and 0?)

57 [ ] 1. YES → Approximately how many months do you estimate it took (or will take) from the time this individual first joined your unit until his direct production was about equal to the production lost by others who were supervising and instructing him? That is, how long was it until his *NET CONTRIBUTION TO UNIT PRODUCTION* was zero?

[ ] 2. NO

58-59 MONTHS: _____

7. Approximately how many months do you estimate it took (or will take) from the time this individual first joined your unit until he required about the same amount of supervision as a qualified specialist?

60-61 MONTHS: _____

7A. How would you rate his *NET CONTRIBUTION TO UNIT PRODUCTION* at that time? (CIRCLE ONE DOT)

62-65

−100	−75	−50	−25	0	+25	+50	+75	+100	+125	+150

−100 means he requires so much supervision that ON NET his presence is like the loss of the average 4 year specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 year specialist

+150 means he is 50% more productive than the average 4 year specialist

8. During his FIRST MONTH with your unit, how many hours per week of direct personal supervision do you estimate this individual received from all supervisors?

66-67 HOURS PER WEEK: _____

9. At the PRESENT TIME, how many hours per week of direct personal supervision do you estimate this individual receives from all supervisors?

68-69 HOURS PER WEEK: _____

10. How would you rate this individual on each of the following? (CIRCLE ONE NUMBER IN EACH ROW)

		1	2	3	4	5	6	7
70	A. WORK ATTITUDE	A very positive attitude						A very negative attitude
71	B. INITIATIVE	Great initiative						Very little initiative
72	C. COOPERATION WITH SUPERVISORS	Excellent cooperation						Very poor cooperation
73	D. AMOUNT OF SUPERVISION	Requires only nominal supervision						Requires constant supervision
74	E. LEVEL OF SKILL	Performs even the most complex tasks in the specialty						Performs only the simplest tasks in the specialty
75	F. SPEED OF WORK	Works very fast						Works very slowly

SECTION III

PART A: TYPICAL NEW TECHNICAL SCHOOL GRADUATE

The following questions apply to the typical or average new TECHNICAL SCHOOL GRADUATE who joins your unit immediately after completing basic training and the technical school course in your specialty.

■CARD 99

1. Do you feel qualified to evaluate the typical new technical school graduate?

31

[ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(SKIP TO PART B)

2. We would like you to estimate the typical new technical school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with 4 years experience, how would you rate the typical new technical school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION:*

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

32-35

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

-100 means he requires so much supervision that that ON NET his presence is like the loss of the average 4 year specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 year specialist

+150 means he is 50% more productive than the average 4 year specialist

B. AFTER 1 YEAR of service? (CIRCLE ONE DOT)

36-39

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

C. AFTER 2 YEARS of service? (CIRCLE ONE DOT)

40-43

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

44-47

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

3. Is the typical new technical school graduate's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his first month? (That is, was your answer to question 2A between -100 and 0?)

48

[ ] 1 YES → Approximately how many months do you estimate it takes from the time the typical new technical school graduate first joins your unit until his direct production is about equal to the production lost by others who supervise and instruct him? That is, how long is it until his *NET CONTRIBUTION TO UNIT PRODUCTION* is zero?

49-50

MONTHS:_____

[ ] 2. NO

PART B: TYPICAL NEW DIRECTED DUTY ASSIGNMENT TRAINEE.

The following questions apply to the typical or average new DIRECTED DUTY ASSIGNMENT TRAINEE who joins your unit immediately after completing basic training.

1. Do you feel qualified to evaluate the typical new directed duty assignment trainee?

51 [ ] 1. YES ▶(CONTINUE)
[ ] 2. NO ▶(STOP HERE)

2. We would like you to estimate the typical new directed duty assignment trainee's *NET CONTRIBUTION TO UNIT PRODUCTION* at several points in his service career *assuming he serves 4 years or more in this shop or section.* An individual's *NET CONTRIBUTION TO UNIT PRODUCTION* is his direct production *minus* production lost by others who supervise and instruct him.

Relative to the average specialist with four years experience, how would you rate the typical new directed duty assignment trainee's *NET CONTRIBUTION TO UNIT PRODUCTION:*

A. During his FIRST MONTH with your unit? (CIRCLE ONE DOT—DOTS ARE AT 5% INTERVALS)

52-55

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

-100 means he requires so much supervision that ON NET his presence is like the loss of the average 4 year specialist

Zero *NET CONTRIBUTION TO UNIT PRODUCTION* means that his direct production is equal to production lost by others who supervise and instruct him

+100 means he is as productive as the average 4 year specialist

+150 means he is 50% more productive than the average 4 year specialist

B. AFTER 1 YEAR of service? (CIRCLE ONE DOT)

56-59

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

C. AFTER 2 YEARS of service? (CIRCLE ONE DOT)

60-63

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

D. AFTER 4 YEARS of service? (CIRCLE ONE DOT)

64-67

-100 -75 -50 -25 0 +25 +50 +75 +100 +125 +150

3. Is the typical new directed duty assignment trainee's *NET CONTRIBUTION TO UNIT PRODUCTION* negative during his first month? (That is, was your answer to question 2A between -100 and 0?)

68 [ ] 1. YES → Approximately how many months do you estimate it takes from the time the typical new directed duty assignment trainee first joins your unit until his direct production is about equal to the production lost by others who supervise and instruct him? That is, how long is it until his *NET CONTRIBUTION TO UNIT PRODUCTION* is zero?

MONTHS:_____

69-70

[ ] 2. NO

Appendix B
TABLES OF PRODUCTIVITY PROFILES

The following tables provide the means and standard deviations of the supervisors' ratings of different categories of trainees at four points in time: (1) upon arrival at their first duty station, (2) one year later, (3) two years later, and (4) four years later. The number of ratings (N) is the number of different ratings that were used in calculating the means.

For each of the four sets of mean ratings (t, Y_t), $t = 0, 12, 24, 48$, a curve of the form

$$y(t) = \alpha - \beta e^{-\gamma t}$$

was fitted by least squares; i.e., the parameters α, β, and γ were chosen to minimize

$$Q = \sum (Y_t - \alpha + \beta e^{-\gamma t})^2.$$

The y-intercept at the curve is $y(0) = \alpha - \beta$. The slope at $t = 0$ is $y'(0) = \beta\gamma$. The error sum of squares is the value of Q when the parameters are replaced by their least-square estimates.

The median training time (T) is the median time between service entry date and date of arrival at the first duty station for the trainees in the survey.

Total first-term productivity (P) is defined by

$$P = (1/100)\int_0^{48-T} y(t)\, dt$$

where y(t) is the fitted curve. Average productivity (A) is the mean value of y(t) over the interval from 0 to 48-T:

$$A = \int_0^{48-T} y(t)\, dt/(48-T) = 100P/(48-T).$$

Table B.1

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 26L
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	21.8 (48.3)	--	-19.0 (46.0)	-31.1 (44.2)
12	64.6 (46.3)	--	48.8 (38.3)	44.7 (39.3)
24	77.5 (54.1)	--	73.8 (35.8)	69.2 (33.2)
48	82.7 (56.4)	--	99.8 (31.8)	94.7 (31.2)
No. of ratings (N)	11	0	25	18
Learning Curve Statistics				
Estimated parameters:				
Alpha	83.2	--	104.9	97.7
Beta	61.4	--	123.3	128.2
Gamma	0.0994	--	0.0620	0.0690
Related statistics:				
Y-intercept	21.8	--	-18.4	-30.5
Slope at t = 0	6.1	--	7.6	8.8
Error sum of squares	0.0	--	18.58	28.45
Median training time (T)	215 days (7.1 mo.)	--	215 days (7.1 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	28.0	--	24.6	26.4
Average productivity: 100(total prod.)/(48-T)	68.4	--	60.2	58.4

Table B.2

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 31E
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	34.7 (52.9)	--	-2.4 (39.0)	-22.5 (46.0)
12	78.9 (34.6)	--	60.4 (34.0)	44.5 (37.0)
24	108.8 (26.2)	--	84.7 (26.5)	76.4 (29.5)
48	126.2 (18.9)	--	108.2 (22.3)	103.7 (27.1)
No. of ratings (N)	17	0	50	49
Learning Curve Statistics				
Estimated parameters:				
Alpha	135.5	--	113.1	112.5
Beta	101.3	--	115.1	134.8
Gamma	0.0518	--	0.0621	0.0560
Related statistics:				
Y-intercept	34.2	--	-2.0	-22.3
Slope at t = 0	5.2	--	7.1	7.5
Error sum of squares	12.17	--	10.88	1.77
Median training time (T)	200 days (6.6 mo.)	--	200 days (6.6 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	38.9	--	29.7	28.7
Average productivity: 100(total prod.)/(48-T)	93.8	--	71.8	63.5

Table B.3

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 63H
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	29.3 (58.2)	32.0 (76.3)	13.1 (41.3)	-15.9 (48.9)
12	69.0 (44.3)	62.6 (75.2)	61.2 (29.1)	42.3 (34.7)
24	88.5 (40.8)	79.5 (79.9)	86.2 (26.0)	75.3 (29.9)
48	104.4 (43.6)	105.5 (55.5)	107.3 (25.3)	99.6 (26.0)
No. of ratings (N)	155	10	202	197
Learning Curve Statistics				
Estimated parameters:				
Alpha	109.7	128.7	115.4	109.9
Beta	80.4	96.2	102.3	126.0
Gamma	0.0561	0.0293	0.0526	0.0528
Related statistics:				
Y-intercept	29.3	32.5	13.1	-16.1
Slope at t = 0	4.5	2.8	5.4	6.7
Error sum of squares	0.19	5.39	0.12	1.45
Median training time (T)	212 days (7.0 mo.)	86 days (2.8 mo.)	212 days (7.0 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	32.1	34.0	30.1	28.0
Average productivity: 100(total prod.)/(48-T)	78.3	75.4	73.5	61.9

Table B.4

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 67N
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	22.2 (41.0)	--	-2.4 (44.6)	-25.9 (49.1)
12	73.8 (32.6)	--	53.6 (38.2)	39.9 (41.6)
24	93.[illegible] (31.5)	--	79.7 (27.5)	70.3 (32.8)
48	110.6 (29.3)	--	105.0 (23.5)	99.2 (27.3)
No. of ratings (N)	36	0	77	70
Learning Curve Statistics				
Estimated parameters:				
Alpha	113.7	--	113.6	108.6
Beta	91.3	--	115.7	134.2
Gamma	0.0665	--	0.0530	0.0541
Related statistics:				
Y-intercept	22.4	--	-2.1	-25.6
Slope at t = 0	6.1	--	6.1	7.3
Error sum of squares	4.14	--	4.07	5.23
Median training time (T)	177 days (5.8 mo.)	--	177 days (5.8 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	35.1	--	28.4	26.4
Average productivity: 100(total prod.)/(48-T)	83.1	--	67.4	58.5

Table B.5

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 67U
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	7.6 (52.7)	--	-3.8 (40.2)	-29.9 (45.5)
12	57.1 (55.3)	--	56.4 (35.6)	34.7 (36.4)
24	76.1 (59.7)	--	82.3 (28.0)	66.6 (32.6)
48	95.3 (63.9)	--	105.7 (24.4)	93.6 (30.5)
No. of ratings (N)	38	0	52	44
Learning Curve Statistics				
Estimated parameters:				
Alpha	99.4	--	111.9	103.0
Beta	91.4	--	115.4	132.7
Gamma	0.0610	--	0.0591	0.0547
Related statistics:				
Y-intercept	8.0	--	-3.5	-29.7
Slope at t = 0	5.6	--	6.8	7.3
Error sum of squares	8.19	--	4.81	0.84
Median training time (T)	189 days (6.2 mo.)	--	189 days (6.2 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	27.7	--	28.9	24.3
Average productivity: 100(total prod.)/(48-T)	66.3	--	69.1	53.8

Table B.6

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 67V
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	17.0 (58.3)	--	-5.9 (41.4)	-25.9 (49.5)
12	66.1 (44.9)	--	52.2 (33.0)	36.9 (37.9)
24	87.0 (44.0)	--	81.1 (27.3)	70.2 (31.6)
48	104.2 (45.0)	--	108.9 (24.6)	103.1 (26.3)
No. of ratings (N)	86	0	132	117
Learning Curve Statistics				
Estimated parameters:				
Alpha	108.3	--	119.7	118.0
Beta	91.2	--	125.4	143.7
Gamma	0.0626	--	0.0504	0.0467
Related statistics:				
Y-intercept	17.1	--	-5.7	-25.7
Slope at t = 0	5.7	--	6.3	6.7
Error sum of squares	1.86	--	2.57	1.98
Median training time (T)	161 days (5.3 mo.)	--	161 days (5.3 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	32.7	--	29.1	26.3
Average productivity: 100(total prod.)/(48-T)	76.5	--	68.2	58.1

Table B.7

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 73C
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	15.2	8.0	3.0	-17.0
	(45.9)	(59.6)	(36.8)	(41.6)
12	69.4	64.2	67.9	53.4
	(37.8)	(38.9)	(27.6)	(32.7)
24	89.9	98.6	90.8	81.8
	(39.2)	(27.6)	(24.0)	(25.4)
48	108.2	128.0	110.5	105.8
	(39.7)	(23.2)	(22.9)	(22.0)
No. of ratings (N)	159	5	191	172
Learning Curve Statistics				
Estimated parameters:				
Alpha	111.5	143.6	113.2	110.9
Beta	96.0	135.8	109.9	127.6
Gamma	0.0659	0.0454	0.0708	0.0644
Related statistics:				
Y-intercept	15.5	7.8	3.3	-16.7
Slope at t = 0	6.3	6.2	7.8	8.2
Error sum of squares	6.18	0.96	9.22	6.18
Median training time (T)	168 days (5.5 mo.)	86 days (2.8 mo.)	168 days (5.5 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	33.7	38.8	33.3	31.4
Average productivity: 100(total prod.)/(48-T)	79.3	85.9	78.5	69.4

Table B.8

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 91B
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	36.7 (53.0)	--	5.8 (44.1)	-9.6 (50.3)
12	74.0 (35.9)	--	62.5 (35.2)	50.5 (36.3)
24	91.5 (34.7)	--	87.2 (30.0)	79.2 (30.7)
48	104.9 (34.8)	--	110.6 (28.9)	106.5 (26.0)
No. of ratings (N)	127	0	241	190
Learning Curve Statistics				
Estimated parameters:				
Alpha	108.8	--	117.2	116.1
Beta	72.1	--	111.1	125.4
Gamma	0.0601	--	0.0569	0.0525
Related statistics:				
Y-intercept	36.7	--	6.1	-9.3
Slope at t = 0	4.3	--	6.3	6.6
Error sum of squares	0.14	--	5.23	3.50
Median training time (T)	154 days (5.1 mo.)	--	154 days (5.1 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	35.6	--	32.5	30.8
Average productivity: 100(total prod.)/(48-T)	83.0	--	75.7	68.2

Table B.9

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 91E
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	39.5 (46.0)	38.0 (62.7)	21.8 (42.3)	-9.9 (51.9)
12	73.8 (38.4)	68.0 (44.6)	69.3 (30.0)	53.4 (33.0)
24	93.7 (36.5)	89.6 (35.7)	90.8 (23.6)	82.9 (23.7)
48	105.7 (35.0)	102.0 (33.3)	108.9 (24.1)	106.4 (23.5)
No. of ratings (N)	133	5	166	117
Learning Curve Statistics				
Estimated parameters:				
Alpha	110.7	109.3	114.0	113.3
Beta	71.4	71.7	92.1	123.1
Gamma	0.0571	0.0498	0.0589	0.0592
Related statistics:				
Y-intercept	39.3	37.6	21.9	-9.8
Slope at t = 0	4.1	3.6	5.4	7.3
Error sum of squares	2.32	8.13	1.28	0.89
Median training time (T)	131 days (4.3 mo.)	86 days (2.8 mo.)	131 days (4.3 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	36.9	36.5	35.4	31.8
Average productivity: 100(total prod.)/(48-T)	84.4	80.8	80.9	70.4

Table B.10

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 11B
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	29.5 (57.4)	21.7 (69.8)	12.9 (40.3)	-6.4 (47.5)
12	55.9 (52.3)	53.8 (49.8)	57.8 (36.0)	48.2 (35.2)
24	75.3 (53.7)	78.0 (49.3)	79.9 (34.4)	78.6 (33.3)
48	91.7 (55.5)	96.2 (53.7)	104.8 (31.4)	106.7 (31.0)
No. of ratings (N)	81	21	160	150
Learning Curve Statistics				
Estimated parameters:				
Alpha	103.5	108.8	115.9	120.0
Beta	74.3	87.5	102.7	126.3
Gamma	0.0388	0.0412	0.0455	0.0468
Related statistics:				
Y-intercept	29.2	21.3	13.2	-6.3
Slope at t = 0	2.9	3.6	4.7	5.9
Error sum of squares	2.24	6.13	4.60	0.17
Median training time (T)	161 days (5.3 mo.)	86 days (2.8 mo.)	161 days (5.3 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	28.7	31.2	30.2	30.5
Average productivity: 100(total prod.)/(48-T)	67.2	69.1	70.6	67.5

Table B.11

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 11E
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	29.7 (53.7)	23.3 (65.3)	9.1 (42.0)	-5.6 (50.4)
12	73.8 (50.0)	47.8 (36.8)	56.9 (32.4)	44.6 (36.5)
24	90.9 (53.0)	70.5 (31.2)	81.9 (27.3)	76.8 (28.9)
48	103.7 (54.0)	98.3 (31.8)	105.6 (27.0)	104.9 (26.5)
No. of ratings (N)	112	6	211	180
Learning Curve Statistics				
Estimated parameters:				
Alpha	106.0	146.7	115.7	121.4
Beta	76.1	123.7	106.4	127.2
Gamma	0.0701	0.0197	0.0486	0.0429
Related statistics:				
Y-intercept	29.9	23.0	9.3	-5.8
Slope at t = 0	5.3	2.4	5.2	5.5
Error sum of squares	1.42	2.52	0.86	1.42
Median training time (T)	150 days (4.9 mo.)	86 days (2.8 mo.)	150 days (4.9 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	35.3	29.3	30.6	29.5
Average productivity: 100(total prod.)/(48-T)	82.0	64.8	71.1	65.2

Table B.12

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 12B
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	18.3	-4.3	6.4	0.5
	(52.4)	(66.4)	(41.2)	(44.4)
12	55.7	29.6	50.1	44.9
	(51.7)	(50.9)	(34.8)	(35.6)
24	75.[illegible]	59.0)	79.0	77.0
	(53.1)	(46.1)	(27.6)	(31.9)
48	91.8	90.0	105.9	105.5
	(55.5)	(44.0)	(25.9)	(27.2)
No. of ratings (N)	129	7	169	139
Learning Curve Statistics				
Estimated parameters:				
Alpha	98.3	127.3	123.5	126.3
Beta	79.9	132.1	117.2	126.2
Gamma	0.0522	0.0266	0.0398	0.0380
Related statistics:				
Y-intercept	18.4	-4.8	6.3	0.1
Slope at t = 0	4.2	3.5	4.7	4.8
Error sum of squares	0.08	5.48	0.90	4.29
Median training time (T)	130 days (4.3 mo.)	86 days (2.8 mo.)	130 days (4.3 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	29.2	22.8	29.7	29.8
Average productivity: 100(total prod.)/(48-T)	66.9	50.4	68.0	66.0

Table B.13

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 13B
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	17.9 (59.7)	45.0 (57.9)	8.2 (43.8)	-14.5 (49.9)
12	52.6 (59.5)	74.4 (43.2)	58.9 (36.4)	44.2 (35.3)
24	72.3 (62.4)	95.0) (35.1)	84.3 (32.2)	77.0 (30.9)
48	91.0 (61.7)	110.0 (40.6)	108.4 (31.8)	105.4 (29.6)
No. of ratings (N)	93	5	173	162
Learning Curve Statistics				
Estimated parameters:				
Alpha	100.4	119.1	117.8	118.2
Beta	82.4	74.4	109.4	132.7
Gamma	0.0452	0.0448	0.0505	0.0487
Related statistics:				
Y-intercept	18.0	44.7	8.4	-14.5
Slope at t = 0	3.7	3.3	5.5	6.5
Error sum of squares	0.07	3.47	1.62	0.0
Median training time (T)	135 days (4.4 mo.)	86 days (2.8 mo.)	135 days (4.4 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	28.1	39.4	32.1	29.2
Average productivity: 100(total prod.)/(48-T)	64.4	87.2	73.6	64.6

Table B.14

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 51B
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	34.8	41.1	1.2	-13.6
	(56.1)	(49.6)	(38.9)	(45.9)
12	65.6	70.4	46.4	33.6
	(49.4)	(34.1)	(33.8)	(39.2)
24	84.2	93.1)	72.8	67.4
	(50.1)	(31.8)	(33.1)	(39.4)
48	101.7	109.6	100.9	97.1
	(49.2)	(31.0)	(32.0)	(36.6)
No. of ratings (N)	51	22	114	118
Learning Curve Statistics				
Estimated parameters:				
Alpha	111.5	121.3	117.6	118.3
Beta	76.7	80.7	116.2	132.2
Gamma	0.0430	0.0412	0.0403	0.0386
Related statistics:				
Y-intercept	34.8	40.6	1.4	-13.9
Slope at t = 0	3.3	3.3	4.7	5.1
Error sum of squares	0.01	6.66	0.62	4.68
Median training time (T)	128 days (4.2 mo.)	86 days (2.8 mo.)	128 days (4.2 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	33.7	38.3	27.6	25.2
Average productivity: 100(total prod.)/(48-T)	77.0	84.7	63.0	55.7

Table B.15

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 64C
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	40.5	15.0	13.5	-7.1
	(52.5)	(40.6)	(43.7)	(49.6)
12	75.5	68.0	61.8	50.8
	(42.1)	(44.3)	(36.1)	(38.2)
24	90.2	97.2	84.3	75.9
	(41.1)	(49.9)	(33.4)	(32.9)
48	100.7	109.0	107.2	101.1
	(43.0)	(45.5)	(29.0)	(28.2)
No. of ratings (N)	124	5	209	195
Learning Curve Statistics				
Estimated parameters:				
Alpha	103.0	113.9	115.3	108.5
Beta	62.4	99.3	101.5	115.2
Gamma	0.0674	0.0681	0.0514	0.0552
Related statistics:				
Y-intercept	40.6	14.6	13.8	-6.7
Slope at t = 0	4.2	6.8	5.2	6.4
Error sum of squares	0.30	12.72	4.05	7.49
Median training time (T)	130 days (4.3 mo.)	86 days (2.8 mo.)	130 days (4.3 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	36.3	37.5	32.8	29.9
Average productivity: 100(total prod.)/(48-T)	82.9	83.1	74.9	66.1

Table B.16

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Army
MOS: 94B
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	40.9	24.4	7.2	-7.5
	(55.3)	(50.0)	(45.1)	(49.5)
12	69.8	45.1	54.4	44.4
	(53.5)	(58.9)	(34.9)	(36.2)
24	87.2	56.3)	80.5	75.6
	(57.3)	(73.4)	(32.0)	(31.9)
48	102.1	76.1	107.0	106.2
	(59.4)	(83.7)	(26.6)	(27.9)
No. of ratings (N)	92	9	176	192
Learning Curve Statistics				
Estimated parameters:				
Alpha	109.8	98.3	120.4	123.8
Beta	68.9	73.4	113.1	131.3
Gamma	0.0460	0.0247	0.0441	0.0418
Related statistics:				
Y-intercept	40.9	24.9	7.3	-7.5
Slope at t = 0	3.2	1.8	5.0	5.5
Error sum of squares	0.17	4.19	0.87	0.01
Median training time (T)	150 days (4.9 mo.)	86 days (2.8 mo.)	150 days (4.9 mo.)	86 days (2.8 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	34.4	24.4	30.0	29.3
Average productivity: 100(total prod.)/(48-T)	79.8	54.1	69.8	64.8

Table B.17

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: AE 8327
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-15.7 (31.9)	--	-24.8 (29.1)	-51.0 (30.2)
12	38.1 (22.2)	--	36.6 (29.7)	13.2 (30.2)
24	71.9 (26.2)	--	73.5 (22.9)	50.5 (26.8)
48	94.7 (36.9)	--	102.3 (13.8)	86.2 (22.8)
No. of ratings (N)	15	0	52	53
Learning Curve Statistics				
Estimated parameters:				
Alpha	105.9	--	116.2	105.1
Beta	122.0	--	141.3	156.0
Gamma	0.0510	--	0.0488	0.0440
Related statistics:				
Y-intercept	-16.1	--	-25.1	-50.9
Slope at t = 0	6.2	--	6.9	6.9
Error sum of squares	6.80	--	2.26	0.10
Median training time (T)	350 days (11.5 mo.)	--	350 days (11.5 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	18.4	--	18.3	17.1
Average productivity: 100(total prod.)/(48-T)	50.5	--	50.2	37.6

Table B.18

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: ET
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-14.0	-35.0	-21.4	-43.0
	(40.1)	(41.4)	(35.1)	(39.5)
12	46.2	51.0	41.6	15.4
	(37.4)	(22.4)	(32.9)	(36.6)
24	73.6	80.7	73.2	49.5
	(37.1)	(25.2)	(26.6)	(32.9)
48	98.5	116.7	98.6	81.1
	(33.9)	(31.2)	(19.1)	(26.7)
No. of ratings (N)	322	3	627	420
Learning Curve Statistics				
Estimated parameters:				
Alpha	106.1	123.6	107.4	97.5
Beta	119.8	157.7	128.8	140.5
Gamma	0.0562	0.0598	0.0556	0.0448
Related statistics:				
Y-intercept	-13.7	-34.1	-21.4	-43.0
Slope at t = 0	6.7	9.4	7.2	6.3
Error sum of squares	3.57	52.53	0.18	0.0
Median training time (T)	226 days (7.4 mo.)	78 days (2.6 mo.)	226 days (7.4 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	23.9	31.5	22.8	17.0
Average productivity: 100(total prod.)/(48-T)	58.9	69.4	56.3	37.5

Table B.19

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: ADJ 8323
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	6.3 (45.7)	--	-14.0 (38.3)	-41.2 (40.5)
12	69.7 (27.8)	--	44.1 (32.5)	23.6 (35.6)
24	98.8 (23.8)	--	74.9 (25.7)	56.9 (32.3)
48	131.0 (26.3)	--	98.6 (26.7)	89.8 (30.6)
No. of ratings (N)	15	0	80	81
Learning Curve Statistics				
Estimated parameters:				
Alpha	143.0	--	107.6	103.8
Beta	136.2	--	121.7	144.7
Gamma	0.0492	--	0.0544	0.0481
Related statistics:				
Y-intercept	6.8	--	-14.1	-40.9
Slope at t = 0	6.7	--	6.6	7.0
Error sum of squares	11.33	--	0.11	2.97
Median training time (T)	240 days (7.9 mo.)	--	240 days (7.9 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	33.5	--	23.3	20.5
Average productivity: 100(total prod.)/(48-T)	83.6	--	58.1	45.0

Table B.20

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: ADJ 8327
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	10.0 (67.0)	--	-17.9 (33.3)	-39.7 (40.4)
12	53.7 (51.7)	--	39.7 (29.1)	16.5 (33.4)
24	87.9 (37.9)	--	73.3 (28.1)	55.0 (28.9)
48	116.0 (30.7)	--	100.2 (24.9)	90.1 (26.8)
No. of ratings (N)	10	0	48	46
Learning Curve Statistics				
Estimated parameters:				
Alpha	138.0	--	112.7	114.0
Beta	128.6	--	130.8	154.0
Gamma	0.0375	--	0.0492	0.0391
Related statistics:				
Y-intercept	9.4	--	-18.1	-40.0
Slope at t = 0	4.8	--	6.4	6.0
Error sum of squares	10.96	--	0.90	3.14
Median training time (T)	230 days (7.6 mo.)	--	230 days (7.6 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	29.0	--	22.6	19.1
Average productivity: 100(total prod.)/(48-T)	71.8	--	55.9	42.0

Table B.21

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: DT
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	42.4 (45.5)	--	9.8 (41.7)	-18.5 (47.1)
12	68.6 (32.0)	--	62.6 (30.7)	42.0 (34.8)
24	89.8 (29.6)	--	83.7 (24.8)	69.8 (27.9)
48	108.3 (25.8)	--	101.3 (22.9)	88.9 (26.5)
No. of ratings (N)	107	0	215	104
Learning Curve Statistics				
Estimated parameters:				
Alpha	124.3	--	104.9	94.0
Beta	82.3	--	94.9	112.5
Gamma	0.0346	--	0.0653	0.0641
Related statistics:				
Y-intercept	42.0	--	10.0	-18.5
Slope at t = 0	2.8	--	6.2	7.2
Error sum of squares	4.04	--	3.38	0.02
Median training time (T)	186 days (6.1 mo.)	--	186 days (6.1 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	33.9	--	30.3	26.1
Average productivity: 100(total prod.)/(48-T)	80.8	--	72.5	57.5

Table B.22

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: EM
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-0.8	19.6	-9.1	-36.5
	(41.5)	(47.9)	(35.9)	(36.3)
12	47.5	48.3	43.0	16.0
	(37.9)	(37.8)	(29.3)	(29.5)
24	73.4	66.3	72.3	48.5
	(39.5)	(42.4)	(25.1)	(26.5)
48	97.6	93.2	99.7	82.9
	(42.6)	(42.8)	(21.7)	(24.7)
No. of ratings (N)	396	11	712	692
Learning Curve Statistics				
Estimated parameters:				
Alpha	108.3	123.3	113.0	105.5
Beta	109.0	103.3	122.1	142.0
Gamma	0.0480	0.0256	0.0460	0.0382
Related statistics:				
Y-intercept	-0.7	20.0	-9.1	-36.5
Slope at t = 0	5.2	2.6	5.6	5.4
Error sum of squares	0.47	2.34	0.14	0.14
Median training time (T)	226 days (7.4 mo.)	78 days (2.6 mo.)	226 days (7.4 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	24.5	28.3	23.4	17.3
Average productivity: 100(total prod.)/(48-T)	60.3	62.2	57.7	38.1

Table B.23

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: HM
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	26.5 (42.8)	3.3 (25.4)	-9.4 (42.4)	-28.7 (47.6)
12	65.8 (38.0)	75.3 (20.3)	51.4 (32.7)	32.6 (39.2)
24	87.0 (38.3)	93.7 (19.0)	79.5 (27.6)	65.0 (33.3)
48	104.5 (38.1)	119.2 (24.2)	101.1 (24.2)	88.4 (29.4)
No. of ratings (N)	50	6	398	219
Learning Curve Statistics				
Estimated parameters:				
Alpha	111.7	120.5	107.2	97.0
Beta	85.2	116.4	116.5	125.8
Gamma	0.0516	0.0713	0.0607	0.0564
Related statistics:				
Y-intercept	26.5	4.1	-9.3	-28.8
Slope at t = 0	4.4	8.3	7.1	7.1
Error sum of squares	0.0	58.45	0.56	0.51
Median training time (T)	194 days (6.4 mo.)	78 days (2.6 mo.)	194 days (6.4 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	31.9	39.1	27.0	23.5
Average productivity: 100(total prod.)/(48-T)	76.7	86.0	64.8	51.7

Table B.24

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: RM
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-6.0 (44.3)	--	-21.2 (39.0)	-42.4 (43.1)
12	51.6 (33.2)	--	43.7 (32.1)	24.1 (36.1)
24	76.8 (32.6)	--	73.3 (27.1)	57.5 (30.6)
48	97.5 (34.0)	--	99.2 (21.8)	90.4 (24.2)
No. of ratings (N)	329	0	504	361
Learning Curve Statistics				
Estimated parameters:				
Alpha	102.8	--	106.9	103.7
Beta	108.7	--	127.8	145.8
Gamma	0.0613	--	0.0573	0.0492
Related statistics:				
Y-intercept	-5.9	--	-20.9	-42.1
Slope at t = 0	6.7	--	7.3	7.2
Error sum of squares	2.06	--	3.09	3.75
Median training time (T)	202 days (6.6 mo.)	--	202 days (6.6 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	26.2	--	24.0	20.7
Average productivity: 100(total prod.)/(48-T)	63.3	--	58.0	45.5

Table B.25

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: CS
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	13.9 (51.9)	65.7 (35.6)	-0.4 (42.9)	-18.4 (48.1)
12	47.3 (44.4)	83.4 (38.8)	45.4 (33.6)	30.6 (35.8)
24	68.9 (44.5)	90.0 (39.4)	73.5 (28.1)	62.5 (30.3)
48	91.1 (47.9)	100.7 (35.0)	99.6 (26.7)	94.8 (26.5)
No. of ratings (N)	242	7	363	355
Learning Curve Statistics				
Estimated parameters:				
Alpha	106.4	104.9	114.5	117.0
Beta	92.6	38.8	114.9	135.5
Gamma	0.0375	0.0443	0.0427	0.0377
Related statistics:				
Y-intercept	13.8	66.1	-0.4	-18.5
Slope at t = 0	3.5	1.7	4.9	5.1
Error sum of squares	0.02	4.28	0.13	0.15
Median training time (T)	150 days (4.9 mo.)	78 days (2.6 mo.)	150 days (4.9 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	26.0	40.1	26.7	23.7
Average productivity: 100(total prod.)/(48-T)	60.5	88.2	62.0	52.2

Table B.26

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: Navy
MOS: MM
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-5.2 (41.8)	--	-17.8 (36.1)	-33.1 (38.5)
12	36.3 (39.1)	--	35.9 (30.9)	20.7 (31.8)
24	63.2 (40.9)	--	67.9 (26.9)	54.9 (28.7)
48	88.5 (43.2)	--	98.3 (23.9)	90.1 (24.7)
No. of ratings (N)	257	0	476	490
Learning Curve Statistics				
Estimated parameters:				
Alpha	104.6	--	115.0	113.7
Beta	109.9	--	132.8	146.8
Gamma	0.0402	--	0.0432	0.0381
Related statistics:				
Y-intercept	-5.3	--	-17.8	-33.1
Slope at t = 0	4.4	--	5.7	5.6
Error sum of squares	0.47	--	0.0	0.01
Median training time (T)	168 days (5.5 mo.)	--	168 days (5.5 mo.)	78 days (2.6 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	22.0	--	23.0	20.0
Average productivity: 100(total prod.)/(48-T)	51.9	--	54.2	43.9

Table B.27

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 304
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-18.5	-25.0	-26.1	-32.8
	(36.2)	(46.8)	(32.6)	(44.2)
12	49.0	43.8	40.4	32.0
	(32.8)	(53.1)	(34.5)	(42.2)
24	76.8	72.3	72.9	66.1
	(31.0)	(36.0)	(24.5)	(32.9)
48	98.3	98.8	97.1	92.8
	(29.9)	(35.4)	(19.2)	(23.6)
No. of ratings (N)	649	4	477	127
Learning Curve Statistics				
Estimated parameters:				
Alpha	102.9	105.3	104.8	102.9
Beta	121.2	129.9	130.8	135.7
Gamma	0.0661	0.0600	0.0590	0.0543
Related statistics:				
Y-intercept	-18.3	-24.6	-26.0	-32.8
Slope at t = 0	8.0	7.8	7.7	7.4
Error sum of squares	2.81	8.72	0.02	0.03
Median training time (T)	300 days (9.9 mo.)	60 days (2.0 mo.)	300 days (9.9 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	22.4	28.2	20.1	24.4
Average productivity: 100(total prod.)/(48-T)	58.7	61.2	52.8	53.1

Table B.28

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 306
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-8.1	--	-16.1	-28.0
	(36.2)		(36.8)	(50.6)
12	51.2	--	44.6	25.1
	(31.1)		(35.2)	(47.7)
24	78.5	--	74.6	62.9
	(28.8)		(26.0)	(37.1)
48	101.7	--	99.0	94.9
	(28.1)		(21.1)	(26.1)
No. of ratings (N)	386	0	289	35
Learning Curve Statistics				
Estimated parameters:				
Alpha	108.6	--	107.3	116.8
Beta	116.5	--	123.3	145.3
Gamma	0.0578	--	0.0559	0.0399
Related statistics:				
Y-intercept	-7.9	--	-16.0	-28.5
Slope at t = 0	6.7	--	6.9	5.8
Error sum of squares	1.86	--	0.36	6.81
Median training time (T)	345 days (11.3 mo.)	--	345 days (11.3 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	22.1	--	20.1	23.1
Average productivity: 100(total prod.)/(48-T)	60.2	--	54.9	50.3

Table B.29

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 326X0
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-28.2 (35.7)	--	-34.4 (34.5)	-86.8 (23.3)
12	42.1 (40.0)	--	29.9 (37.0)	-37.7 (44.9)
24	72.2 (35.4)	--	66.4 (29.5)	14.6 (33.6)
48	102.6 (23.5)	--	99.2 (15.5)	98.2 (20.0)
No. of ratings (N)	93	0	51	11
Learning Curve Statistics				
Estimated parameters:				
Alpha	111.3	--	114.9	599.7
Beta	139.1	--	149.3	687.3
Gamma	0.0556	--	0.0469	0.0066
Related statistics:				
Y-intercept	-27.8	--	-34.4	-87.6
Slope at t = 0	7.7	--	7.0	4.5
Error sum of squares	11.90	--	0.01	9.19
Median training time (T)	313 days (10.3 mo.)	--	313 days (10.3 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	20.0	--	16.9	3.2
Average productivity: 100(total prod.)/(48-T)	53.1	--	44.9	7.0

Table B.30

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 326X1
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-21.7 (39.6)	--	-31.4 (37.9)	-34.6 (38.4)
12	55.6 (35.6)	--	38.1 (34.8)	39.2 (36.4)
24	83.4 (33.8)	--	73.2 (27.5)	73.9 (29.7)
48	105.6 (32.4)	--	98.9 (20.2)	96.9 (31.0)
No. of ratings (N)	145	0	87	13
Learning Curve Statistics				
Estimated parameters:				
Alpha	108.7	--	107.6	103.4
Beta	130.1	--	139.0	138.0
Gamma	0.0721	--	0.0580	0.0640
Related statistics:				
Y-intercept	-21.4	--	-31.4	-34.6
Slope at t = 0	9.4	--	8.1	8.8
Error sum of squares	8.88	--	0.07	0.08
Median training time (T)	267 days (8.8 mo.)	--	267 days (8.8 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	25.7	--	20.7	27.2
Average productivity: 100(total prod.)/(48-T)	65.4	--	52.8	59.0

Table B.31

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 326X2
Skill level: High

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-18.0 (33.0)	--	-29.9 (31.7)	-37.1 (35.8)
12	47.7 (32.0)	--	40.6 (31.7)	16.5 (38.3)
24	74.3 (30.6)	--	71.5 (23.4)	55.2 (29.4)
48	96.0 (29.9)	--	96.5 (19.8)	80.4 (25.5)
No. of ratings (N)	216	0	102	26
Learning Curve Statistics				
Estimated parameters:				
Alpha	100.5	--	102.9	95.7
Beta	118.3	--	132.6	133.5
Gamma	0.0653	--	0.0617	0.0466
Related statistics:				
Y-intercept	-17.8	--	-29.7	-37.8
Slope at t = 0	7.7	--	8.2	6.2
Error sum of squares	4.29	--	2.67	19.67
Median training time (T)	211 days (6.9 mo.)	--	211 days (6.9 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	24.4	--	22.5	18.8
Average productivity: 100(total prod.)/(48-T)	59.4	--	54.7	40.7

Table B.32

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 421
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-8.3 (42.8)	--	-19.8 (40.5)	-26.1 (50.2)
12	51.3 (33.8)	--	41.1 (33.0)	30.7 (34.7)
24	74.7 (32.9)	--	68.9 (25.7)	64.4 (29.8)
48	92.5 (32.6)	--	93.6 (19.8)	92.8 (26.3)
No. of ratings (N)	467	0	344	92
Learning Curve Statistics				
Estimated parameters:				
Alpha	95.8	--	101.0	106.9
Beta	103.9	--	120.6	133.1
Gamma	0.0690	--	0.0568	0.0470
Related statistics:				
Y-intercept	-8.1	--	-19.6	-26.2
Slope at t = 0	7.2	--	6.9	6.3
Error sum of squares	2.68	--	3.04	0.60
Median training time (T)	205 days (6.7 mo.)	--	205 days (6.7 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	25.3	--	22.5	24.1
Average productivity: 100(total prod.)/(48-T)	61.4	--	54.5	52.4

Table B.33

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 422X1
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-4.0 (38.3)	--	-15.5 (37.2)	-31.1 (45.4)
12	53.8 (35.0)	--	42.6 (30.1)	19.8 (38.7)
24	77.6 (34.5)	--	71.2 (24.8)	55.7 (33.6)
48	97.5 (33.9)	--	96.6 (19.2)	83.6 (29.7)
No. of ratings (N)	185	0	125	28
Learning Curve Statistics				
Estimated parameters:				
Alpha	101.9	--	105.6	101.3
Beta	105.7	--	121.0	132.9
Gamma	0.0637	--	0.0534	0.0427
Related statistics:				
Y-intercept	-3.8	--	-15.4	-31.6
Slope at t = 0	6.7	--	6.5	5.7
Error sum of squares	3.52	--	1.33	8.52
Median training time (T)	175 days (5.8 mo.)	--	175 days (5.8 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	27.6	--	24.3	19.9
Average productivity: 100(total prod.)/(48-T)	65.3	--	57.6	43.2

Table B.34

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 422X2
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-11.9 (39.0)	--	-13.9 (37.1)	-13.8 (49.1)
12	43.2 (39.7)	--	52.0 (30.1)	35.0 (36.8)
24	65.3 (40.9)	--	77.5 (24.4)	64.3 (30.0)
48	85.4 (41.6)	--	100.2 (20.2)	90.7 (23.7)
No. of ratings (N)	85	0	79	28
Learning Curve Statistics				
Estimated parameters:				
Alpha	89.8	--	104.6	104.8
Beta	101.4	--	118.2	118.6
Gamma	0.0623	--	0.0648	0.0445
Related statistics:				
Y-intercept	-11.6	--	-13.6	-13.8
Slope at t = 0	6.3	--	7.7	5.3
Error sum of squares	5.69	--	8.37	0.15
Median training time (T)	146 days (4.8 mo.)	--	146 days (4.8 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	23.6	--	28.1	25.0
Average productivity: 100(total prod.)/(48-T)	54.7	--	64.9	54.4

Table B.35

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 423
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-23.5 (36.4)	--	-26.4 (36.5)	-29.7 (40.6)
12	37.2 (35.4)	--	31.9 (35.1)	29.0 (36.2)
24	64.7 (34.4)	--	64.4 (27.5)	67.2 (29.5)
48	90.1 (31.8)	--	94.2 (18.9)	95.5 (23.2)
No. of ratings (N)	299	0	227	44
Learning Curve Statistics				
Estimated parameters:				
Alpha	97.8	--	108.2	110.8
Beta	121.0	--	134.6	140.9
Gamma	0.0559	--	0.0470	0.0471
Related statistics:				
Y-intercept	-23.2	--	-26.4	-30.1
Slope at t = 0	6.8	--	6.3	6.6
Error sum of squares	4.17	--	0.14	7.14
Median training time (T)	178 days (5.9 mo.)	--	178 days (5.9 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	21.6	--	20.9	24.5
Average productivity: 100(total prod.)/(48-T)	51.3	--	49.6	53.2

Table B.36

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 431
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-4.5 (44.5)	--	-12.8 (37.1)	-22.7 (44.9)
12	53.2 (33.2)	--	47.5 (32.2)	31.4 (36.1)
24	78.5 (31.4)	--	75.9 (25.4)	62.1 (28.6)
48	98.5 (30.7)	--	100.8 (21.4)	94.6 (23.3)
No. of ratings (N)	624	0	432	147
Learning Curve Statistics				
Estimated parameters:				
Alpha	103.6	--	108.8	112.7
Beta	107.9	--	121.4	135.2
Gamma	0.0623	--	0.0558	0.0416
Related statistics:				
Y-intercept	-4.3	--	-12.6	-22.5
Slope at t = 0	6.7	--	6.8	5.6
Error sum of squares	1.44	--	2.05	1.31
Median training time (T)	158 days (5.2 mo.)	--	158 days (5.2 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	28.2	--	26.8	24.2
Average productivity: 100(total prod.)/(48-T)	66.0	--	62.6	52.5

Table B.37

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 432
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-0.8 (45.0)	--	-17.5 (36.6)	-21.5 (45.4)
12	51.7 (35.5)	--	41.8 (31.9)	33.3 (37.5)
24	77.7 (34.4)	--	72.7 (26.6)	67.4 (32.0)
48	99.1 (34.0)	--	101.2 (21.4)	97.2 (29.7)
No. of ratings (N)	662	0	510	174
Learning Curve Statistics				
Estimated parameters:				
Alpha	106.4	--	113.0	113.8
Beta	107.2	--	130.3	135.4
Gamma	0.0555	--	0.0497	0.0441
Related statistics:				
Y-intercept	-0.8	--	-17.3	-21.6
Slope at t = 0	5.9	--	6.5	6.0
Error sum of squares	0.33	--	0.98	0.95
Median training time (T)	145 days (4.8 mo.)	--	145 days (4.8 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	28.4	--	25.7	25.7
Average productivity: 100(total prod.)/(48-T)	65.8	--	59.4	55.9

Table B.38

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 542
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-4.4	-11.5	-0.9	-35.0
	(51.4)	(52.0)	(41.0)	(40.7)
12	43.1	35.5	48.8	25.0
	(32.4)	(34.1)	(29.5)	(34.6)
24	67.3	68.4	76.6	58.7
	(27.4)	(31.0)	(24.3)	(28.4)
48	87.4	93.3	100.5	92.4
	(26.4)	(23.5)	(18.7)	(19.6)
No. of ratings (N)	25	20	47	46
Learning Curve Statistics				
Estimated parameters:				
Alpha	94.8	108.7	111.3	109.8
Beta	99.1	120.6	112.2	144.6
Gamma	0.0539	0.0437	0.0489	0.0439
Related statistics:				
Y-intercept	-4.3	-11.9	-0.9	-34.8
Slope at t = 0	5.3	5.3	5.5	6.3
Error sum of squares	0.15	7.62	0.01	0.87
Median training time (T)	146 days (4.8 mo.)	60 days (2.0 mo.)	146 days (4.8 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	24.4	26.1	27.9	22.0
Average productivity: 100(total prod.)/(48-T)	56.4	56.8	64.6	47.7

Table B.39

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 543
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	-5.4 (43.8)	--	-12.5 (37.6)	-33.0 (47.3)
12	49.2 (35.4)	--	47.6 (32.4)	26.8 (40.5)
24	73.7 (34.3)	--	73.1 (27.3)	56.6 (33.9)
48	93.5 (33.7)	--	96.9 (23.5)	88.7 (29.6)
No. of ratings (N)	271	0	194	61
Learning Curve Statistics				
Estimated parameters:				
Alpha	98.9	--	103.1	102.7
Beta	104.1	--	115.3	135.3
Gamma	0.0606	--	0.0587	0.0465
Related statistics:				
Y-intercept	-5.2	--	-12.2	-32.6
Slope at t = 0	6.3	--	6.8	6.3
Error sum of squares	1.26	--	6.13	5.95
Median training time (T)	191 days (6.3 mo.)	--	191 days (6.3 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	25.5	--	25.1	21.6
Average productivity: 100(total prod.)/(48-T)	61.0	--	60.1	46.9

Table B.40

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 671
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	5.1 (44.9)	--	-7.0 (39.7)	-34.9 (42.2)
12	66.0 (34.7)	--	55.7 (31.4)	34.0 (36.1)
24	90.6 (29.9)	--	82.7 (23.8)	71.1 (27.3)
48	108.3 (29.6)	--	105.2 (20.7)	100.5 (19.0)
No. of ratings (N)	121	0	130	62
Learning Curve Statistics				
Estimated parameters:				
Alpha	111.8	--	110.8	112.2
Beta	106.5	--	117.6	147.1
Gamma	0.0692	--	0.0616	0.0529
Related statistics:				
Y-intercept	5.3	--	-6.8	-34.9
Slope at t = 0	7.4	--	7.2	7.8
Error sum of squares	1.47	--	3.07	0.11
Median training time (T)	154 days (5.1 mo.)	--	154 days (5.1 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	33.4	--	29.8	26.3
Average productivity: 100(total prod.)/(48-T)	77.8	--	69.5	57.1

Table B.41

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 902
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	10.2 (49.3)	12.1 (53.2)	-1.7 (41.5)	-31.4 (44.4)
12	65.1 (37.4)	62.4 (36.0)	62.5 (28.2)	39.8 (34.5)
24	87.7 (34.9)	86.9 (35.2)	85.7 (24.8)	71.1 (28.3)
48	107.2 (36.8)	109.3 (33.5)	107.7 (24.2)	99.7 (23.5)
No. of ratings (N)	229	193	264	275
Learning Curve Statistics				
Estimated parameters:				
Alpha	111.6	117.3	111.3	107.7
Beta	101.2	105.0	112.6	138.8
Gamma	0.0627	0.0529	0.0663	0.0577
Related statistics:				
Y-intercept	10.4	12.3	-1.3	-31.1
Slope at $t = 0$	6.3	5.6	7.5	8.0
Error sum of squares	3.83	1.50	12.48	6.40
Median training time (T)	131 days (4.3 mo.)	90 days (3.0 mo.)	131 days (4.3 mo.)	90 days (3.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	33.7	34.8	32.6	26.2
Average productivity: 100(total prod.)/(48-T)	77.0	77.3	74.6	58.3

Table B.42

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 981
Skill level: Medium

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	16.5	5.5	13.4	-32.1
	(43.1)	(42.7)	(38.4)	(39.3)
12	72.3	68.0	69.6	48.7
	(30.5)	(21.5)	(28.9)	(30.2)
24	96.8	98.8	89.9	77.7
	(27.5)	(18.7)	(20.1)	(24.1)
48	110.8	114.3	105.3	100.4
	(25.9)	(21.0)	(20.4)	(20.6)
No. of ratings (N)	146	29	127	120
Learning Curve Statistics				
Estimated parameters:				
Alpha	114.2	119.2	107.4	103.5
Beta	97.7	113.9	93.9	135.3
Gamma	0.0711	0.0686	0.0735	0.0728
Related statistics:				
Y-intercept	16.5	5.3	13.5	-31.8
Slope at t = 0	6.9	7.8	6.9	9.8
Error sum of squares	0.22	4.33	3.56	8.86
Median training time (T)	166 days (5.5 mo.)	90 days (3.0 mo.)	166 days (5.5 mo.)	90 days (3.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	35.5	37.8	33.5	28.7
Average productivity: 100(total prod.)/(48-T)	83.5	84.0	78.7	63.8

Table B.43

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 552
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	0.7	6.8	4.3	-28.7
	(34.8)	(49.1)	(37.2)	(40.3)
12	40.2	49.4	49.1	23.9
	(40.1)	(29.7)	(28.4)	(27.0)
24	63.8	72.3	73.0	56.8
	(44.3)	(30.4)	(24.1)	(24.6)
48	91.1	98.6	97.6	91.4
	(40.0)	(37.5)	(21.8)	(23.6)
No. of ratings (N)	37	22	53	65
Learning Curve Statistics				
Estimated parameters:				
Alpha	109.7	113.0	109.4	114.4
Beta	108.9	105.9	104.9	143.1
Gamma	0.0366	0.0411	0.0451	0.0380
Related statistics:				
Y-intercept	0.8	7.1	4.5	-28.7
Slope at t = 0	4.0	4.4	4.7	5.4
Error sum of squares	0.95	2.80	1.41	0.05
Median training time (T)	134 days (4.4 mo.)	60 days (2.0 mo.)	134 days (4.4 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	24.1	30.1	27.7	21.5
Average productivity: 100(total prod.)/(48-T)	55.3	65.5	63.5	46.8

Table B.44

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 571
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	10.2	1.6	6.4	-33.9
	(46.0)	(48.5)	(34.3)	(51.2)
12	53.3	44.6	53.0	25.8
	(39.0)	(36.6)	(30.9)	(36.2)
24	77.6	71.3	79.5	59.3
	(39.°)	(31.3)	(25.5)	(29.8)
48	97.2	103.3	104.6	97.2
	(39.8)	(26.0)	(20.6)	(20.5)
No. of ratings (N)	130	44	129	113
Learning Curve Statistics				
Estimated parameters:				
Alpha	105.8	128.0	117.2	119.5
Beta	95.7	126.2	110.7	153.0
Gamma	0.0504	0.0339	0.0452	0.0398
Related statistics:				
Y-intercept	10.1	1.8	6.5	-33.5
Slope at $\tau = 0$	4.8	4.3	5.0	6.1
Error sum of squares	0.19	0.99	0.11	3.50
Median training time (T)	134 days (4.4 mo.)	60 days (2.0 mo.)	134 days (4.4 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	29.2	29.5	30.0	22.7
Average productivity: 100(total prod.)/(48-T)	67.1	64.1	68.9	49.4

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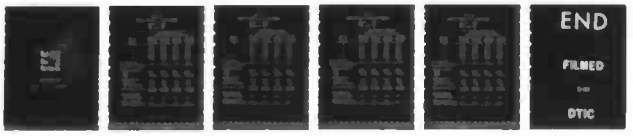

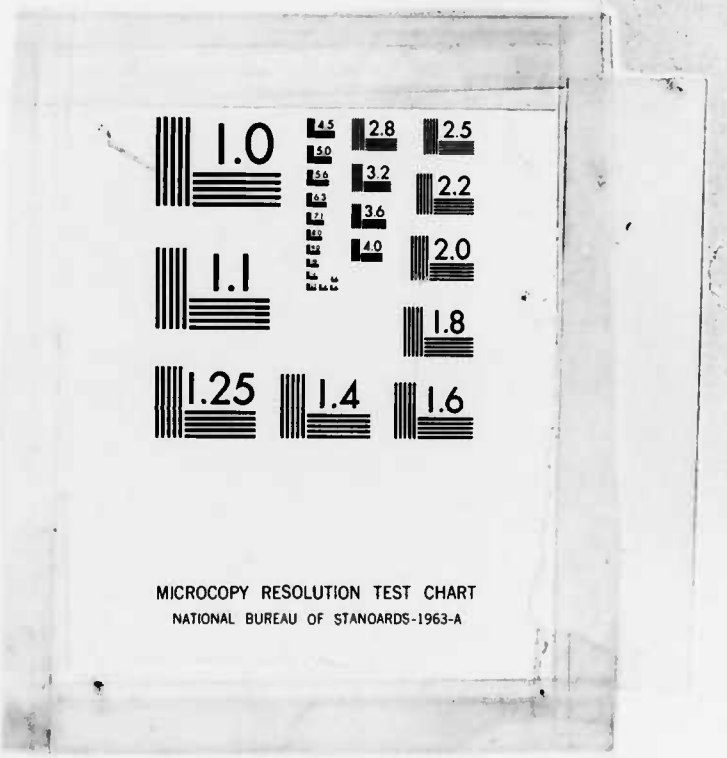
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Table B.45

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 603
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	13.3 (65.7)	25.9 (49.2)	3.1 (46.5)	-5.8 (43.6)
12	67.7 (27.8)	64.3 (34.9)	57.3 (35.6)	54.3 (34.2)
24	87.5 (20.5)	85.0 (32.4)	81.5 (34.0)	77.8 (27.4)
48	100.0 (7.6)	101.3 (33.0)	102.2 (22.9)	101.4 (21.5)
No. of ratings (N)	6	148	74	278
Learning Curve Statistics				
Estimated parameters:				
Alpha	101.7	107.8	108.0	106.7
Beta	88.3	81.9	104.7	112.1
Gamma	0.0783	0.0530	0.0591	0.0603
Related statistics:				
Y-intercept	13.4	25.9	3.3	-5.4
Slope at t = 0	6.9	4.3	6.2	6.8
Error sum of squares	0.91	0.05	2.13	11.25
Median training time (T)	139 days (4.6 mo.)	60 days (2.0 mo.)	139 days (4.6 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	33.3	35.5	30.5	31.7
Average productivity: 100(total prod.)/(48-T)	76.6	77.2	70.3	68.8

Table B.46

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 622
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	13.5	26.8	0.9	-17.5
	(46.0)	(47.1)	(39.3)	(46.7)
12	48.1	65.4	50.7	39.3
	(41.3)	(42.9)	(29.3)	(37.4)
24	72.1	81.6	78.4	68.0
	(42.1)	(42.4)	(25.3)	(31.3)
48	93.1	97.5	103.2	98.3
	(43.8)	(45.1)	(25.7)	(23.7)
No. of ratings (N)	140	28	161	167
Learning Curve Statistics				
Estimated parameters:				
Alpha	107.2	101.7	114.6	111.6
Beta	94.0	74.7	113.7	128.8
Gamma	0.0399	0.0575	0.0478	0.0466
Related statistics:				
Y-intercept	13.2	27.0	0.9	-17.2
Slope at t = 0	3.8	4.3	5.4	6.0
Error sum of squares	1.85	3.38	0.04	4.34
Median training time (T)	128 days (4.2 mo.)	60 days (2.0 mo.)	128 days (4.2 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	27.5	34.7	29.3	27.0
Average productivity: 100(total prod.)/(48-T)	62.8	75.5	67.0	58.6

Table B.47

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 631
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	6.7	-0.5	9.9	-29.9
	(53.4)	(55.8)	(39.5)	(47.6)
12	70.7	71.7	71.4	47.1
	(36.7)	(36.2)	(28.5)	(36.0)
24	88.3	91.6	90.7	78.4
	(36.7)	(33.5)	(23.4)	(27.6)
48	102.4	106.2	107.5	101.1
	(31.8)	(33.3)	(22.6)	(22.8)
No. of ratings (N)	231	142	333	350
Learning Curve Statistics				
Estimated parameters:				
Alpha	102.6	106.4	108.8	105.6
Beta	95.6	106.6	98.6	135.4
Gamma	0.0875	0.0901	0.0769	0.0686
Related statistics:				
Y-intercept	7.0	-0.2	10.2	-29.8
Slope at t = 0	8.4	9.6	7.6	9.3
Error sum of squares	10.75	10.10	11.00	2.38
Median training time (T)	129 days (4.2 mo.)	60 days (2.0 mo.)	129 days (4.2 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	34.2	37.3	35.2	29.7
Average productivity: 100(total prod.)/(48-T)	78.2	81.1	80.5	64.5

Table B.48

PRODUCTIVITY PROFILE OF FIRST-TERM PERSONNEL

Service: USAF
MOS: 647
Skill level: Low

Time on the Job (Months)	Mean Productivity Ratings (Standard deviations in parentheses)			
	Tech School Graduates in Survey	Direct Duty Trainees in Survey	Typical Tech School Graduate	Typical Direct Duty Trainee
0	19.1 (49.4)	46.1 (43.3)	8.1 (40.6)	-26.1 (47.2)
12	67.5 (30.5)	72.8 (48.3)	66.2 (31.2)	41.2 (38.2)
24	91.4 (28.6)	85.6 (57.3)	88.8 (25.2)	74.2 (30.3)
48	111.3 (26.8)	97.2 (74.0)	110.1 (21.9)	103.4 (24.1)
No. of ratings (N)	174	9	199	192
Learning Curve Statistics				
Estimated parameters:				
Alpha	118.1	101.2	114.5	113.7
Beta	98.9	55.0	106.1	139.6
Gamma	0.0552	0.0539	0.0627	0.0537
Related statistics:				
Y-intercept	19.2	46.2	8.4	-25.9
Slope at t = 0	5.5	3.0	6.7	7.5
Error sum of squares	0.36	0.46	8.24	1.80
Median training time (T)	111 days (3.6 mo.)	60 days (2.0 mo.)	111 days (3.6 mo.)	60 days (2.0 mo.)
Total productivity: (Area under curve from 0 to 48-T)/100	36.0	37.2	34.9	28.5
Average productivity: 100(total prod.)/(48-T)	81.2	80.9	78.7	62.0

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